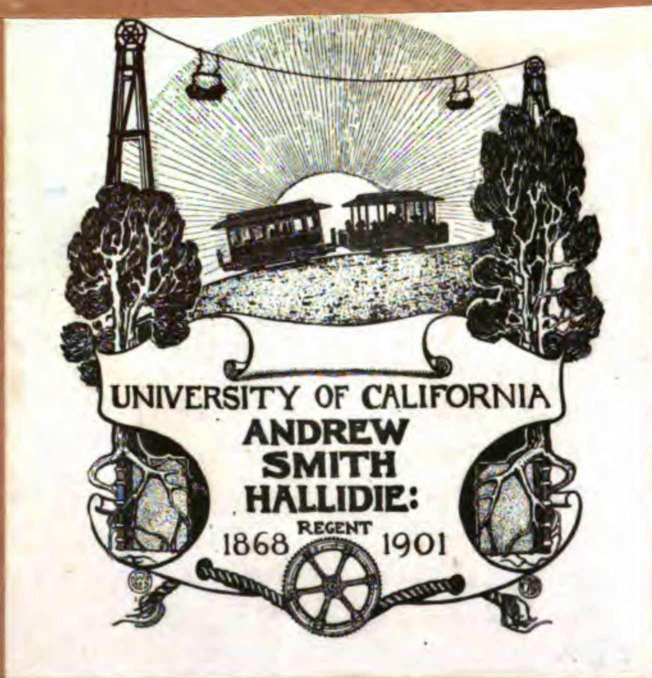
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JOURNAL

OF THE

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VOLUME LIII.

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1905.

Journal of the Society of Arts.

No. 2,713.] FRIDAY, NOVEMBER 18, 1904. [Vol. LIII.

ONE-HUNDRED-AND-FIFTY-FIRST SESSION, 1904-1905.

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-hundred-and-Fifty-First Session was held on Wednesday Evening, the 16th of November, when an Address was delivered by Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

November 23.—Ben. H. Morgan, "The Systematic Promotion of British Trade."

" 30.—Arthur Lee, J.P., "The British Canals Problem." The Right Hon. Sir Michael Hicks-Beach, Bart., D.C.L., M.P., will preside.

December 7.—Walter Francis Reid, F.C.S., "The International Exhibition at St. Louis." Dr. Boverton Redwood, F.C.S., will preside.

" 14.—Charles D. Abel, "The Patent Laws."

INDIAN SECTION.

Thursday Afternoons, at 4.30 o'clock :—

DECEMBER 8.—SIR FREDERIC FRYER, K.C.S.I., "Burma." The RIGHT HON. the EARL OF HARDWICKE, Under Secretary of State for India, in the chair.

January 19, February 16, March 16, April 6, May 11.

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 o'clock :—

January 24, February 28, March 28, May 23.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

DECEMBER 20 (8 p.m.).—THOMAS GRAHAM JACKSON, R.A., "Street Architecture."

January 31, February 21, March 21, April 11, May 16.

For Meetings after Christmas :—

SIR WILLIAM H. PREECE, K.C.B., F.R.S., "The Navigation of the Nile."
KILLINGWORTH HEDGES, M.Inst.C.E, "The Protection of Buildings from Fire."
SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B., "The Present Aspect of the Fiscal Question."
The RIGHT HON. SIR HERBERT MAXWELL, BART., M.P., "British Woodlands."
JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E., "The Supply of Electricity."
R. CHILD BAYLEY, "Time Development in Photography, and Modern Mechanical Methods of carrying it out."
HON. ROBERT P. PORTER, "London Electric Railways."
ARTHUR GULSTON, "Lake Baikal and its Connection with the Great Siberian Railway."
JOHN E. BORLAND, "The true Musical Pitch of Notes we See and Sounds we Hear."
MONSIEUR LALIQUE (Paris), "Popular Jewelry." (*Applied Art Section.*)
SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E., "The Cape to Cairo Railway." (*Colonial Section.*)

CANTOR LECTURES.

Monday Evenings, at 8 o'clock :—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with illustrations on various wind instruments in solo and concerted music).

November 28, December 5, 12, 19.

LECTURE I.—NOVEMBER 28.—Introduction—Music and the practical arts—Division of instruments into string, wind, and percussion—Limitation of definition—Wind instruments and the human voice—Acoustics and the art of instrument making—Vibration and wave motion—Every wind instrument a vibrating column of air—Stationary waves—Means of exciting vibration—Wave-form—Classification into brass, reed, and flute.

LECTURE II.—DECEMBER 5.—*Brass Instruments.*—Primitive instruments from horns and shells—Harmonic scale—Development into bugle and trumpet types—Natural horns and trumpets—Introduction of slides, keys, and valves.

LECTURE III.—DECEMBER 12.—*Reed Instruments.*—Single and double reeds—Conical and cylindrical tubes—Bagpipes—Shawms, oboes, and bassoons—Clarionets—Saxophones.

LECTURE IV.—DECEMBER 19.—*Flutes.*—Modern limitation of the name—Action of the air-reed—Recorders and flageolets—Cone and cylinder flutes.

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Fountain, and Stylographic Pens." Three Lectures.
January 23, 30, February 6.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.
February 13, 20, 27, March 6.

HENRY LAWS WEBB, "Telephony." Four Lectures.
March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.
May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc.M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.
May 15, 22.

JUVENILE LECTURES.

Wednesday Evenings, January 4 and 11, 1905, at 5 o'clock.

CARMICHAEL THOMAS, Treasurer of the Society, "The Production of an Illustrated Newspaper."

CONVERSAZIONE.

The Annual Conversazione of the Society will probably be held on Thursday, June 29, 1905, Each member is entitled to a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade. and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department or science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

COLONIAL SECTION.—The Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies. Four or more Meetings are held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of from two to six Lectures.

ADDITIONAL LECTURES.—Special Courses of Lectures are occasionally given.

JUVENILE LECTURES.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—Examinations, founded in 1853, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal elements of Commercial Education, and Music. Full particulars of the Examinations can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

Every Member whose subscription is not in arrear is entitled:—

To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him, at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary*.

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1904-1905. It is issued subject to any necessary alterations:—

NOVEMBER, 1904.

1	Tu	
2	W	
3	Th	
4	F	
5	S	
6	S	
7	M	
8	Tu	
9	W	
10	Th	
11	F	
12	S	
13	S	
14	M	
15	Tu	
16	W	Opening Meeting of the Session
17	Th	
18	F	
19	S	
20	S	
21	M	
22	Tu	
23	W	Ordinary Meeting
24	Th	
25	F	
26	S	
27	S	
28	M	Cantor Lecture I. 1
29	Tu	
30	W	Ordinary Meeting

DECEMBER, 1904.

1	Th	
2	F	
3	S	
4	S	
5	M	Cantor Lecture I. 2
6	Tu	
7	W	Ordinary Meeting
8	Th	Indian Section
9	F	
10	S	
11	S	
12	M	Cantor Lecture I. 3
13	Tu	
14	W	Ordinary Meeting
15	Th	
16	F	
17	S	
18	S	
19	M	Cantor Lecture I. 4
20	Tu	Applied Art Section
21	W	
22	Th	
23	F	
24	S	
25	S	Christmas Day
26	M	*Bank Holiday*
27	Tu	
28	W	
29	Th	
30	F	
31	S	

JANUARY, 1905.

1	S	
2	M	
3	Tu	
4	W	Juvenile Lecture I.
5	Th	
6	F	
7	S	
8	S	
9	M	
10	Tu	
11	W	Juvenile Lecture II.
12	Th	
13	F	
14	S	
15	S	
16	M	
17	Tu	
18	W	Ordinary Meeting
19	Th	Indian Section
20	F	
21	S	
22	S	
23	M	Cantor Lecture II. 1
24	Tu	Colonial Section
25	W	Ordinary Meeting
26	Th	
27	F	
28	S	
29	S	
30	M	Cantor Lecture II. 2
31	Tu	Applied Art Section

FEBRUARY, 1905.

1	W	Ordinary Meeting
2	Th	
3	F	
4	S	
5	S	
6	M	Cantor Lecture II. 3
7	Tu	
8	W	Ordinary Meeting
9	Th	
10	F	
11	S	
12	S	
13	M	Cantor Lecture III. 1
14	Tu	
15	W	Ordinary Meeting
16	Th	Indian Section
17	F	
18	S	
19	S	
20	M	Cantor Lecture III. 2
21	Tu	Applied Art Section
22	W	Ordinary Meeting
23	Th	
24	F	
25	S	
26	S	
27	M	Cantor Lecture III. 3
28	Tu	Colonial Section

MARCH, 1905.

1	W	Ordinary Meeting
2	Th	
3	F	
4	S	
5	S	
6	M	Cantor Lecture III. 4
7	Tu	
8	W	Ordinary Meeting
9	Th	
10	F	
11	S	
12	S	
13	M	Cantor Lecture IV. 1
14	Tu	
15	W	Ordinary Meeting
16	Th	Indian Section
17	F	
18	S	
19	S	
20	M	Cantor Lecture IV. 2
21	Tu	Applied Art Section
22	W	Ordinary Meeting
23	Th	
24	F	
25	S	
26	S	
27	M	Cantor Lecture IV. 3
28	Tu	Colonial Section
29	W	Ordinary Meeting
30	Th	
31	F	

APRIL, 1905.

1	S	
2	S	
3	M	Cantor Lecture IV. 4
4	Tu	
5	W	Ordinary Meeting
6	Th	Indian Section
7	F	
8	S	
9	S	
10	M	
11	Tu	Applied Art Section
12	W	Ordinary Meeting
13	Th	
14	F	
15	S	
16	S	
17	M	
18	Tu	
19	W	
20	Th	
21	F	Good Friday
22	S	
23	S	Easter Sunday
24	M	*Bank Holiday*
25	Tu	
26	W	
27	Th	
28	F	
29	S	
30	S	

MAY, 1905.

1	M	Cantor Lecture V. 1
2	Tu	
3	W	Ordinary Meeting
4	Th	
5	F	
6	S	
7	S	
8	M	Cantor Lecture V. 2
9	Tu	
10	W	Ordinary Meeting
11	Th	Indian Section
12	F	
13	S	
14	S	
15	M	Cantor Lecture VI. 1
16	Tu	Applied Art Section
17	W	Ordinary Meeting
18	Th	
19	F	
20	S	
21	S	
22	M	Cantor Lecture VI. 2
23	Tu	Colonial Section
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	S	
29	M	
30	Tu	
31	W	Ordinary Meeting

JUNE, 1905.

1	Th	
2	F	
3	S	
4	S	
5	M	
6	Tu	
7	W	
8	Th	
9	F	
10	S	
11	S	Whit Sunday
12	M	*Bank Holiday*
13	Tu	
14	W	
15	Th	
16	F	
17	S	
18	S	
19	M	
20	Tu	
21	W	
22	Th	
23	F	
24	S	
25	S	
26	M	
27	Tu	
28	W	Annual General Meeting
29	Th	*Conversazione*
30	F	

The Cantor Lectures will commence at Half-past Four or Eight o'clock.

The Ordinary Meetings will commence at Eight o'clock.

The Meetings of the Indian Section and the Colonial Section will commence at Half-past Four o'clock.

The Meetings of the Applied Art Section will commence at Half-past Four or Eight o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Five o'clock.

NOTICES.

"JOURNAL" NEW COVER.

The present number of the *Journal*, the first of the new volume, is issued with a new cover, which has been kindly designed for the Society by Mr. Lewis Foreman Day, Vice-President of the Society.

CANTOR LECTURES ON OILS AND FATS.

Dr. J. Lewkowitsch's Cantor Lectures on "Oils and Fats: their Uses and Applications," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor lectures, which have been published separately, and are still on sale, can be obtained on application to the Secretary.

SECTIONAL COMMITTEES.

Applied Art Section Committee.

The following is the list of the Applied Art Section Committee as appointed by the Council:—

Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S. (Chairman of the Council).
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D. (Chairman of the Committee).
Thomas Armstrong, C.B.
George Frederick Bodley, A.R.A.
Prof. A. H. Church, M.A., F.R.S., F.C.S.
Sir Caspar Purdon Clarke, C.I.E.
Alan S. Cole, C.B.
Sidney Colvin, M.A.
Walter Crane, R.W.S.
Henry Hardinge Cunynghame, C.B.
Cyril Davenport.
Lewis Foreman Day.
Alfred East, A.R.A.
Arthur Evans, F.R.S.
Sir John Evans, K.C.B., D.C.L., LL.D., F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
J. Starkie Gardner,
William Gowland, F.S.A.
Gerald C. Horsley.
Arthur Lasenby Liberty.
Seymour Lucas, R.A.
Sir Edward J. Poynter, P.R.A.
Sir Walter S. Prideaux.
Halsey Ralph Ricardo.
Alexander Siemens.
A. B. Skinner, B.A., F.S.A.
John Sparkes.
R. Phené Spiers, F.S.A.
Hugh Stannus, F.R.I.B.A.
H. H. Statham, F.R.I.B.A.
Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S.
Carmichael Thomas.
Sir John I. Thornycroft, LL.D., F.R.S.
Sir Thomas Wardle.
Henry B. Wheatley, F.S.A. (Secretary).

ST. LOUIS EXHIBITION.

List of Awards to Members of the Society of Arts.

The following are additional to the list in last week's number of the *Journal*:—

G. T. Beilby, Silver Medal.
Brown Hoisting Machinery Company (E. L. Leeds), Grand Prize.
Cassal Gold Extracting Company (G. T. Beilby), Gold Medal.
Castner-Kellner Alkali Company (G. T. Beilby), Gold Medal.
Edward Cook and Co., Ltd. (Samuel Hall), Grand Prize.
Corbyn, Stacey and Co., Ltd. (Samuel L. Stacey), Gold Medal.
Debenham and Freebody (Frank Debenham), Gold Medal.
Miss Annie Garnett, Bronze Medal.
W. W. Greener (C. E. Greener), Grand Prize.
Howards and Sons, Ltd. (David Howard), Grand Prize.
Nobel's Explosives Co. Ltd. (Thomas Johnston), Grand Prize.
James Pain and Sons (James C. Pain, Junr.), Two Gold Medals.
South Metropolitan Gas Co. (Sir George T. Livesey), Gold Medal.
Stothert and Pitt, Ltd. (Walter Pitt), Gold Medal.
Swan, Hunter, and Wigham Richardson, Ltd. (George D. Hunter), Gold Medal.
Wardle and Co. (G. G. MacWilliam), Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 16th, 1904; Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S., Vice-President and Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Aiyangar, S. Krishnasvami, M.A., Central College, Chamarajendrapet, Bangalore City, India.
Aldridge, Walter H., Canadian Pacific Railway Company, Canadian Smelting Works, Trail, British Columbia.
Alexander, W. W., The Town Clerk, Heidelberg, Transvaal, South Africa. (P.O. Box 201.)
Anderson, Robert Bruce, Assoc.M.Inst.C.E., 5, Westminster-chambers, S.W.
Attridge, Ernest William, Simons Town, Cape Colony, South Africa.

Austin, Henry B., J.P., Government Offices, Bloemfontein, Orange River Colony, South Africa.
Ayton, Ernest F., M.Am.I.M.E., Apartado Postal 141, Parral, Estado de Chihuahua, Mexico.
Ballantyne, William Smith, Mortgage-buildings, Pretoria, Transvaal, South Africa.
Balta, José, Ministerio de Fomento, Lima, Peru, South America.
Barnes, F. J., Portland Stone Quarries, Isle of Portland, Dorset.
Barton, Geoffrey Berkley, Guntakal, Southern Mahratta Railway, Madras, India.
Bellamy, Franklin J., Yeovil.
Bird, Frank Noel, A,M.I.Mech.E., Wellington Mills, Dardanup, Western Australia.
Black, Francis, R.B.A., Crofton, Mountfield-road, Church-end, Finchley, N.
Bodkin, Archibald Henry, 5, Paper-buildings, Temple, E.C.
Boot, W. H. J., R.B.A., Markeaton, Well-road, Hampstead, N.W.
Bourke, E. F., The Bourke Trust and Estate Company, P.O. Box 321, Pretoria, Transvaal, South Africa.
Brassey, The Hon. Thomas Allnutt, 4, Great George-street, S.W., and Park-gate, Battle, Sussex.
Buller-Allan, Edward, M.D., Maldon, Victoria, Australia.
Burns, Thomas, 25, Diana-street, Newcastle-on-Tyne.
Burton, Joseph James, Rosecroft, Nunthorpe R.S.O., Yorks.
Butler, Edwin T., 26, Craven-park, Willesden, N.W.
Carr-Calthrop, Colonel C. W., M.D., 51, Pembridge-villas, Notting-hill-gate, W.
Chand, Rai Bahadur Lal, M.A., Chief Court, Lahore, India.
Chilvers, George William, 59, Stile Hall-gardens, Chiswick, W.
Church, Harry, 138, Crystal Palace-road, East Dulwich, S.E.
Clark, Augustus, M.I.Mech.E., Recife, Pernambuco, Brazil, South America.
Clark, George Stirling, 35, Upper Belgrave-road, Clifton, Bristol.
Clayton, Charles E., A.I.E.E., City of London Asylum, near Dartford, Kent.
Cobbe, Hervic Nugent Grahame, F.G.S., care of Kalgurli Gold Mines, Ltd., Kalgoorlie, Western Australia.
Cock, Edward A. Langslow, Seremban, Federated Malay States.
Colston, Miss Lilian, 34, Curzon-street, Mayfair, W.
Cottingham, Captain Henry Langrishe, R.A., 70, Carlton-mansions, Maida Vale, W.
Dale, Thomas Henry, M.R.C.V.S., Government Experimental Farm, Potchefstroom, Transvaal, South Africa.
Däll, Alexander Percival, N.G.S.Ry., Secunderabad, Deccan, India.
Darby, Arthur Ernest, A.M.I.Mech.E., Town Hall, Wolverhampton.
Dickens-Lewis, George Edwards, Talbot-chambers, Shrewsbury.
Docker, Edward, Etaples, Pas de Calais, France.
Dollar, John A. W., F.R.S.E., 56, New Bond-street, W.
Dove, Frederick L., 15, Studd-street, Islington, N.
Ebstein, Mrs. Bertha, Leighton-house, Adrian-road, Stamford-hill, Durban, Natal, South Africa.
Edge, S F., 3, Whitehall-court, S.W.
Edmonds, Captain Richard James, H.M. Gun Wharf, Portsmouth.
Ekberg, Miss Annie Elizabeth, Doveton-street, Ballarat, Victoria, Australia.
Enraght-Moony, Francis, Resident Commissioner, Mbabane, Swaziland, South Africa.
Fennell, John Howard, Rio Tinto, Spain.
Fleming, Robert, 2, Princes-street, E.C.
Forrest, George Topham, County Architects' Department, County Hall, Wakefield.
Fox, Alfred, jun., Assoc.M.Inst.C.E., care of Señor J. E. Harmsen, Arequipa, Peru, South America.
Frodsham, Harold, A.I.E.E., "E.C." Powder Works, Bean, *viâ* Dartford, Kent.
Fullwood, John, R.B.A., Studio, Slinfold, Horsham, Sussex.
Furnivall, F., East India United Service Club, 16, St. James's-square, S.W.
Galbraith, David Rankin Shirreff, F.I.C., Galbraith Iron and Steel Co., Ltd., P.O. Box 371, Auckland, New Zealand.
Gardner, Richard Core, 173, Fleet street, E.C.
German, Bernard Foster, care of Messrs. Grindlay and Co., Calcutta, India.
Gibbings, Major Henry Cornwall Cotton, Junior Naval and Military Club, 96, Piccadilly, W.
Gledhill, Gideon, Northfield, Edgerton, Huddersfield.
Gordon, Vivian, The Vache Park, Chalfont St. Giles, Bucks.
Granger, John Maxwell, care of Mrs. J. Mackenzie, Buller-street, Cambridge, East London, South Africa.
Grayson, George E., F.R.I.B.A., Greenbank, Egerton-park, Rock Ferry, Cheshire.
Greenwood, William, M.Inst.C.E., Cape Government Railways, Prieska, Cape Colony, South Africa.
Greg, Lionel Hyde, Dowlaishweram, Godavari District, Madras, India.
Grieve, James Henry, Assoc.M.Inst.C.E., El Damer, Sudan, Egypt.
Groves, Thomas, A.M.I.Mech E., Taiping, Perak, Federated Malay States.
Gurtoo, R., Chandni Chauk, Cuttack, Orissa, Bengal, India.
Hamilton, Charles Joseph, B.A., F.S.S., University College, Cardiff.

Harper, James, Assoc.M.Inst.C.E., Ferro-Carril Nord Este Argentino, Monte Caseros, Argentine Republic.

Hawthorn, John Henry, M.A., Municipal Technical School, The Newarke, Leicester.

Heron, J. S., Pennant-hills, New South Wales, Australia.

Higgs, Frederick, Station Works, Loughborough Junction, S.E.

Hollis, Sydney Ainslie, A.M.I.Mech.E., Town Hall, Bloemfontein, Orange River Colony, South Africa.

Hope-Edwards, Lieut.-Col. Herbert J., Netley Hall, Shrewsbury.

Houghton, Bernard, Moulmein, Burma.

Hutton, Richard B., Aldersbrook-house, Forest-drive, Manor-park, Essex.

Irani, Rustomji Hormusji, Thull-Parachinar Railway Survey, Thull, India.

Jackson, David Hamilton, Ph.D., M.A., 47, Mecklenburg-square, W.C.

Jeff, William, Northfleet District Engineering Works, Northfleet, Kent.

Jeffries, Joseph, A.M.I.E.E., 29, Court-road, Balsall-heath, Birmingham.

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The CHAIRMAN delivered the following

ADDRESS.

The annual address of the Chairman of your Council is an occasion on which he can express his views on passing events, even though they may have no immediate connection with the actual work of the Society of Arts. But as the Society takes cognisance of every thing that affects the progress, extension, and knowledge of arts, manufactures and commerce, I am in hopes that I may not be accused of taking for my subject a topic on which I ought not to touch. Last year, owing to circumstances which then existed, I felt I ought in my address to enter somewhat fully into the connection between commercial education and our examinations. I stated, amongst other things, that it appeared to me that the time must come when the Board of Education would have to be asked to consider whether it should not take over our examinations, for the good reason that the Society was actually undertaking a work of great public utility in examining the results of the instruction in commercial subjects largely given in evening schools which were subsidised by the Board. The prophecy that I made last year regarding the increase in the number of papers for this year has approximately been verified, as stated in our annual report, and I see no reason to doubt that the estimate I gave will be pretty nearly realised in the coming and immediate future years supposing no disturbing influence takes place. I should like to remark that the experience in science and art examination work indicates that the annual increase of students in evening classes in years when trade is bad has always been considerably larger then when trade is good, and it may be that in the coming year when trade is not in a flourishing condition, the increase may even exceed that which I estimated. In any case, as I have said before, the time must come before long when the numbers of candidates examined will be beyond the grip of the machinery which exists at the Society and then Government will have to be approached. But it is not only in the case of such examinations that the State should be asked to take a definite responsibility. I have long held that

there is a certain class of work performed by institutions which should undoubtedly be carried on by some department of the State, specially devoted to such work.

The work to which I refer is such as is not suitable, or to be expected from societies or individuals. It is work which is continuous and must expand in the flux of time, which is recognised by the public as useful, which is not and cannot be remunerative, which requires a staff larger than is required by the ordinary demands of a society, and which cannot be dropped without serious detriment to the public.

The functions of scientific societies are as a rule indicated by their names. Societies are formed to foster the advancement of certain particular branches of science by research. A research may be laborious and lengthy, but it is not necessarily continuous, and the funds of the society and the members are sufficient for the purpose. There are exceptions to such societies and these are found in two of the three oldest societies, one our own Society and the other the Royal Society. The one was formed for the encouragement of commerce, art and industry, and the other for the promotion of natural knowledge. I have already alluded to the examination work which answers to my definition, carried on by the Society of Arts, but there is even a still stronger case for the relief by the State of certain administrative functions which are at present carried on by the Royal Society. I may merely mention the fact that it is responsible for the administration of the Government grant of £4,000 a year for research, which by itself is quite proper, but it is also responsible for the National Physical Laboratory, and for the Meteorological Office. It seems to me self-evident that these two are institutions at all events which are of national importance and answer to my definition, and ought to be administered by a Department of State on the advice of a scientific body.

When there is some pressing need Government does administer branches of a department which has to carry out scientific investigation. Thus the medical branch of the Local Government Board has been laboriously and gradually built up. It is far otherwise, however, with that scientific work which has no department specially interested in or needing it, though it is for the public weal, as the State departments only exist for ministering to that weal, it appears that some department should be created or enlarged to take charge of them. This view, which I have long held, has been more than confirmed by the evidence given before a recent Committee, which the Treasury practically appointed, to consider the present position of the Meteorological Office, but limiting the recommendation to be made so far as the grant made to it is concerned. As the Committee's report is published there is no occasion for me to be reticent of what passed nor as to what conclusions the Committee arrived at. I need scarcely point out that the Meteorological Office is perhaps a better known public institution than many of those under State control. Its history is peculiar, and is worth sketching, for it shows that the State has always, in regard to it, been averse to taking any responsibility for scientific research, however utilitarian, preferring to place the burden on the shoulders of some already weighted society such as the Royal Society, and considers that it has done its duty when it gives grants in aid, usually inadequate after a short lapse of time to carry out the work. Such grants being stereotyped, proper and justifiable expansion become impossible. The Board of Trade in 1855 started what is called forecasting, under the well-known Admiral FitzRoy, having asked the Royal Society their opinion of the way in which it was proposed to make the observations. The Royal Society approved of the proposed plan.

On the death of Admiral FitzRoy the Royal Society were again approached by the Board of Trade as to what course should be pursued in regard to the organisation of meteorological work, which a committee appointed by them had recommended, and the Royal Society's reply was to the effect that "the collection and dispersion of observations were best entrusted to a scientific body furnished with funds," and "responsible to Parliament," but that "storm warnings ought to be managed directly by a Government department." I will not weary my audience as to details, suffice it to say the Treasury objected to the separation of research and storm warnings as proposed, though its necessity is evident on many grounds. The President and council of the Royal Society thereupon, in the self-sacrificing spirit which they ever show, appointed an unpaid standing committee to superintend the meteorological observations to be made for the Board of Trade, and a sum of £10,000 was placed at its disposal. The standing committee were known as the Meteorological Committee.

The Royal Society, in 1875, indicated in new negotiations entered into by Government that the Meteorological Office should be a Government department, with a man of science responsible, under a Minister of the Crown at the head of it; but failing that, a Meteorological Council should be formed. This last, the bad alternative, was adopted in 1877, the Treasury being careful to avoid any action which might have a semblance of giving the Council or any of the staff any Government status. With the exception of the addition of a few hundred pounds given for a special object, the grant to the Meteorological Council has remained at the same figure as then allotted, viz., £15,000. The needs of the forecasting and oceanic meteorological branches, it may well be supposed, did not remain stationary, though the grant, out of which this continuous work and research had to be paid, did, neither did the men who composed the staff of the office remain at the same age between 1877 and now, and the question of pensioning those who have done good service became a pressing matter in 1898. The Treasury having refused to treat the staff as civil servants, the Meteorological Council acting in accordance with the wishes of the Royal Society, were obliged to set aside a fairly large slice of the annual grant to form a pension fund, and economies were forced on them which have restricted, and will restrict not only the necessary research work but the very usefulness of the office unless some relief be given. Amongst other things, the Observatory on Ben Nevis was warned that the small pittance which it had annually received would be cut off, and I have no doubt that this warning served on a Scottish Observatory was the cause of the late official inquiry.

It is needless to say that in the intervening years advance in meteorological science has been greatly retarded in Great Britain by want of funds. Perhaps the latest example occurred in 1902, when there was a proposal to obtain further information about atmospheric currents and conditions by the use of balloon and kite observations, an international scheme of work being contemplated. The small sum of £500 a year would have been necessary to carry out this research, but the Royal Society was obliged, on behalf of the Meteorological Office, to reply that they had no funds, a reply which it would have been difficult to make had the Meteorological Office been part of a Government department. Let us look across the water at our American cousins and see how they regard the science of meteorology, and whether or not it is important enough to attach it to the State. According to evidence given to the committee, the Weather Bureau in America, corresponding to our Meteorological Office and forming part of the Department of Agriculture, was spending £230,000 a year on the same work as that of the Meteorological Committee, whose funds at the maximum were confined to £15,300. In Germany, where very large sums are spent on the oceanic part of meteorology, it is a part of the Navy Department. We, with our splendid navy and mercantile marine, surely ought to see that this part of meteorology is as well cared for as it is in Germany, and that there is no lack of funds. The evidence given before the Committee showed that without the help of the hydrographic branch of the Navy the work could not have been carried on with anything like success. I am not intending to enter into a discussion of meteorological science, but it has been pointed out that if forecasts are any good (and we have it on record that from 68 and 75 per cent. of them are successful) they ought to be made as good as possible. There is no doubt that kite and balloon observations, and the use of wireless telegraphy in mid-ocean would give a still higher percentage of successful forecasts. But the additions must remain in abeyance owing to the money limit which has been fixed at the same standard for so many years.

Again, we find that a very large item of expenditure by the Meteorological Office is the cost of telegrams. It has to pay the same price for the use of the Post Office telegraphs as any private individual, whereas every Government office has the free use of the wires, and has not to consider whether a telegram runs to 12 or 120 words, or whether it sends one or 100. The main object of the Meteorological Office is to assist the public, and this is the same as that of Government departments, yet the one is hampered by the cost of publishing information (which to be of the greatest use must be transmitted at once) whilst the other is not. The view of the committee which sat was strongly that this disability ought to be removed, so that wide publicity to weather reports, especially in harvest time, should be given. Finally, the committee almost unanimously reported in favour of the office being attached to some Government department, and proposed that this should be the Board of Agriculture, a department which at present is not overweighted.

I must remind you that our great Indian dependency has been more alive to the question of meteorology than we have at home; but I trust that, backward as we are, we may, before long, attain that excellence of administration which the Indian Meteorological Department has exhibited under its present and past able administrators.

What Government intend to do with the committee's report I do not know. Judging from previous history there seems to be a dread at the Treasury of any of the present departments having more to do with science than is absolutely forced upon them. Perhaps this is natural. The lay official mind has, with some few exceptions, never fully grasped the importance of orderly and continued scientific investigation in order to increase national prosperity. It recognises it in a way, for its need is continually brought before them by the Press, but to it the easiest plan is to leave all such investigation to societies. In Great Britain it has never been realised that to foster such work is a duty of the nation. We have ignored the very patent fact that in free America and in other countries the necessity of annexing to the State all utilitarian research (when such research is carried out with the definite object of public usefulness) is fully recognised. I am not proposing for an instant that the work which is carried out by individuals or societies should be curtailed, but there are questions which are too large, too expansive, and bearing too much on the public weal which should be dealt with in Great Britain as it they are (say) America.

I suppose that Treasury negotiations will be opened with the Royal Society, who are now responsible for the Meteorological Office, and I should not be very much surprised if the same class of correspondence which was brought before the committee takes place in the present as it did in the past, If the Royal Society are wise, as I hope they will be, and not too willing to give way, as they often are, they will utterly refuse to be responsible for the meteorological observations, seeing the inadequacy of the sum placed at their disposal for the purpose of that office, and will support the committee's views, that it should form part of some Government department.

I have only so far referred to the Meteorological Committee, but, at all events, there is the other institution, which I have already mentioned, the National Physical Laboratory, which should come into the same category of quasi-public departments.

The necessity of a National Physical Laboratory was pointed out in 1891, by Sir Oliver Lodge, in his address as president of the Mathematical Section of the British Association, and this was further emphasised by Sir Douglas Galton, the President of the Association in 1895. Men of science, and heads of large industries pressed Government for aid in establishing such a laboratory, which was to standardise and verify instruments for testing materials, and to determine physical constants. Such a work as this, was far beyond the scope or means of any society, and yet, for the advancement of trade, the time had come when Great Britain sought to rely on its own resources for obtaining accurate standardising, and not to be forced to seek it abroad in establishments founded and supported by foreign States. At the head of the Government of the day was Lord Salisbury, whose well-known sympathies for science made him take a favourable view of the project, and the result was that the Government consented to help. The Government intended to be and was generous to it at its start, as it, no doubt, intended to be to the Meteorological Committee in the first instance. It has given the National Physical Laboratory buildings, and a sum of £19,000 to make the additions to them, which were absolutely necessary to commence with. It granted £4,000 a year for four years, and afforded assistance to it through the Office of Works. The National Physical Laboratory is under the ægis of the Royal Society, is controlled by a general committee of experts and an executive committee chosen from the former. They have Lord Rayleigh for its chairman and the great advantage of the presence of the Secretary of the Board of Trade as one of its most active members.

The term of years for which the grant was made runs out in March next, and its financial position has to be reviewed by the State through the Treasury.

Its existence and development has become a necessity through the excellent work that it has already done. Taking the year 1903, 1,340 tests were made for the public in subjects very diverse in nature. Thus tests were made for resistance coils, electrical supply meters, varieties of thermometers, gauges, density determinations, capacities of glass vessels, examination of specimens of metal, steel analysis, incandescent lamps, photographic lenses, vacuum

pressure gauges, strength of materials. It appears also that 29,477 instruments were verified, and the remark in the committee's report is one of interest in regard to the last numbers. They say, "It will be noticed that there is a fall of 3,500 in the number of clinical thermometers tested" in comparison with the previous year. *Verbum sap*, Great Britain was at war in that year, so that the services of the National Physical Laboratories were utilised amonst other things for Government. But it is also mentioned that there is work of first-class importance to the public which it has been forced to refuse owing to lack of funds. Standardising is not a luxury in the present day, and England has suffered much in its trade owing to the want of it.

I cannot do better than quote a German Press comment which the director, Mr. Glazebrook, also quoted in his paper on the Laboratory at the recent meeting of the British Association. The *Deutsche Mechanische Zeitung*, in June of this year, when commenting on the figures I have here given, writes:—"Our German instrument-making trade has every cause to watch carefully the development of the National Physical Laboratory, and to take timely precautions before the advantages which it has already secured against English competition are too seriously reduced." I suspect if more aid be not promptly given, that the precautions they may propose to take will be unnecessary. They may then look with satisfaction at their own bureaux, which they know are properly equipped and imperially supported. The following table will show the amounts granted by the different States in regard to these laboratories:—

Here we have a direct comparison of grants and turn-out of work. Great Britain, I think I may say, has no reason to be ashamed of the work, though it has of the grants. In connection with the results given in the Table, I may point out that France and the United States started their institutions after the inauguration of our own laboratory. It may be they profited by our mistakes, or, more likely, viewed the importance of the work to be carried on from a higher standpoint than ourselves. Nevertheless, with only the example of Germany to guide them, and probably entertaining the opinion that German views of scientific research are extravagant, I think, as I have said before, that the Treasury were generous at the time, but with the later experience of what France and the United States have since done, a liberal review of the further needs of the Laboratory should be entertained.

The idea of making any such institution a State institution, it may be supposed, was never entertained by the Government, such a notion being foreign to existing precedent. The precedent—bad precedent too—had to govern the situation. We have only to look across the Atlantic to see how our Anglo-Saxon cousins treat such matters. There, institutions such as I have here described, are part and parcel of a State department, and have a handsome annual grant allotted to them. The Government of the United States recognised the public need, and so did Congress, with the result that the public need is catered for by a public department as it should be.

In regard to the National Physical Labora-

Country.	Name.	Lost.		Annual Grant.	Receipts from annual work.	No. of tests made.	Staff.
		Building.	Equipment.				
Germany	Reichsantalt.	200,000		16,000	3,000†	22,469	112
	Aichungskom-mission	48,000		8,500	—	—	—
	Versuchsanstalt.	137,000		15,000	8,000†	5,000	140
		£385,000		39,500	11,000	27,469	252
France........	Laboratoire de l'état.	27,000 and some buildings.	20,000	5 500	—	—	12
U.S.A.	Bureau of Standards.	70,000	45,000	19,000	114‡	1·666‡	22
Great Britain ..	National Physical Laboratory.	19,000 including some buildings.	*	4,000	4,042§	30,807§	50

* The annual grant was made before the work was started, and any balance left after paying salaries I believe was available for apparatus.
† In these cases the State takes the fees.
‡ For the 1st year.
§ Includes the Observatory Department.

tory, it is no secret that at the present moment it is hampered by want of funds for equipment and staff. Its refusal of work has only proceeded from this cause. The report which it issued showed that its expenditure had been larger than its income of £9,000, an income which is derived from a variety of sources:—Treasury grant, £4,000; Gassiot Fund, £400 (about); from Meteorological Committee, £400; fees, &c., £4,200 (about). In addition to this there has been £1,200 in donations. It is quite natural and right that the commercial and scientific position of such institutions should be reviewed from time to time, but surely it is better that its necessities should be recognised annually as in America rather than every five, ten, or twenty years, as it may be with us. If progress such as is necessary, and is expected from them, is to be made, their financial wants should be known and considered at much shorter periods.

Whether the Laboratory can become self-supporting is a matter of doubt to my mind. Even if it should be so, that is no reason for taking it away from State control, which always gives an impress to decisions, and it is a pledge that gain is not its only object. Certainly it would never arrive at the proportions that the huge more than self-supporting department, the Post Office, has arrived at. The example of Germany, where the State takes the fees, and supports the institution, is worth following.

I might refer to researches in solar physics also, which are carried out in the iron shanties at South Kensington, under the control of the Board of Education. The sum of £700 is allotted as a grant in aid for the work that is carried out there, and some of the staff are borne on the estimates, but if, as is to be believed, some of the tremendous problems of the causes of famine and plenty are dependent on the solar phenomena, then this work should be enlarged and encouraged. The expenditure of ten times the sum in one year may enable millions of pounds and lives to be saved which may be lost from the scant supply of needful means. It is true that the Solar Physics Observatory is under the Board of Education, but if its history were written, I doubt not that it would be found that from its very first inception (due to the repeated recommendation of a host of scientific men who foresaw something of what might be expected from it) the State wanted none of it. It may be said that if the Meteorological Office and the National Physical Laboratory were attached to a Government department, they might be starved in the same way. I do not believe it possible that such should be the case, for these two are of ostensible use to the ordinary public, and appeal to that most sagacious and popular person the man in the street, in a way that solar physics does not. The last deals with problems which are for future use, but it is intimately, most intimately, connected with meteorology. If the Meteorological Office becomes attached, as it eventually must be, to a Government department, the Solar Physics Observatory and staff should be attached to the same department.

There is another reason for attaching these institutions to the State, and this I have referred to in a previous paragraph, viz., the question of staff. Supervision must be scientific, and may be carried out by a scientific committee, changes in which caused by death or other causes are gradual, so that one scientific man replaces another, and the continuity of the supervision is maintained. Scientific supervising committees have a distinct advantage over any casual scientific advice which is called in by a Government office. The selection of advisers by a political or permanent head of of an office, is a task for which few are desirous to undertake, owing to causes to which I need not refer. The services of such a committee may be gratuitous, as it is in other advisory committees, and I may add that men of science, like men of standing in other walks of life, are ever ready to give their services for such a purpose. But when we consider the position of what ought to be the permanent staff, the conditions are completely different. I need not ask you whether the permanent staff of a Government office would care to work on the same terms as those of the staff of one of these quasi-public offices. If a man is in the former he knows that given health and fair service he will be entitled to a pension which at all events will enable him to end his days respectably, but if he is in the latter he knows that his pension, if any, will be inadequate, and that his salary will not bear comparison with that of men who, in somewhat the same position of responsibility, have a pension secured to them. He further knows that any pension he may get will be at the expense of those researches which he is supposed to aid. It has been said that the man who is without a pension should save. So he ought, but as everyone knows, there is always

an excuse, particularly where the salary is small, for spending money on which a man can lay his hand. It is far better for some one else to be provident for him. It is no use wasting time on platitudes as to thrift. Take an Englishman who has no private means of his own, and unless he has a strength of mind and capacity for self-denial which is possessed by only a very small per-centage of the populace he will leave the office a pauper and will probably become an object of charity.

If the Government will recognise the two institutions as doing essentially public service, and ask for the necessary funds, I believe Parliament would vote the supplies in the same ungrudging manner that Congress has done, as they would look upon them as a paying investment. Parliament realises most frequently before Government does the importance of any public work. The most happy solution of the problem would be (1) to have some department of State to which these and other kindred scientific institutions should be attached; (2) to have a scientific advisory board; (3) to distinguish clearly between grants for research, equipment, and material and those for staff.

The question may be asked as to what department these various institutions should be attached, and how such a branch of it as deals with science should be arranged?

Had the Department of Science and Art been in existence, I should not have hesitated in thinking that its functions should have been enlarged, and that, besides supervising science, technical, and art instruction, it should have had charge of the various institutions to which I have referred. Its very designation would have made it right and proper. To a certain extent the other departments recognised it as something more than an educational department. The Foreign Office and various other State departments frequently referred to it for purposes other than educational, and it had the advantage of having at its command the services of that distinguished body of men who are attached to the Royal College of Science, also its science examiners, who were mostly Fellows of the Royal Society. This department was thus enabled to give opinions and advice, which were the reflex of those of the upper ten of science. That department is now defunct and merged in the Board of Education, but still has atached to it, besides its educational colleges, the Solar Physics Observatory and the Geological Survey. I do not know whether the Board of Education would undertake any new duty when its hands are full with the new problems in education and its administration. If not, it would seem that the department, which has not as yet been over-burdened, would be the Board of Agriculture, which already administers the Fisheries, the Ordnance Survey, and Kew Gardens. In regard to the advisory board, all evidence points to seeking the advice of the Royal Society. The Treasury, India Office, and other offices refer matters for the consideration of the Council of the Royal Society. The references are many, and the Fellows willingly give their time on the various committees which are formed to report on the various subjects. The Royal Society is, as I have said, responsible for the annual grant of £4,000 given by Government, for research, for the Meteorological Office and for the National Physical Laboratory. As a Fellow of that society I am delighted that the Government recognise that it can justly have every confidence in its advice and guidance in all matters of science. It is the natural body to which to look for scientific advice, as it has in its ranks the most prominent men of science in all branches.

For this reason I should deprecate any departure from the existing practice of constituting it the adviser to the Government, and should any department be formed to take special cognisance of science, I think that it should have the council of the Royal Society as an advisory body. This would have the advantage of stereotyped advice not being tendered. The annual changes of a part of the Council whilst preserving continuity prevent grooves being made. The Council should, of course, have perfect freedom as to the method it might choose to adopt in arriving at any opinion. Nor would I propose any departure from the principle that the advice given should be in the future as in the past—unpaid for—except so far that the funds of the society should in no ways suffer, owing to its taking upon it this advisory position. Any extra expenditure due to this cause should be defrayed by the department it advises. Further, having this advisory body there should be at the head of that branch of the department some eminent man of science, with some scientific assistants, who would be enabled to understand in its full bearings the nature of the advice offered, for it is not always that even a really efficient Civil servant is enabled to distinguish between physics and medicine. There might be other dangers in not having a man of science as chief of the branch

which it is not needful to specify. I would even go so far as to say that the advisory board should be consulted as to obtaining a fit and proper person to fill the post. With a department looking after the administration of these bodies, there would be but slight danger that the charges on the estimates would not be appropriated as proposed. Such a department should be responsible for all scientific branches of work which were not strictly educational or departmental. Thus the Survey, the National Physical Laboratory, the Meteorological Office, and the Solar Physics would, at all events, be under its rule, and the administration of the grants in aid to the various bodies which now receive them should be part of its functions.

Another function that it should undertake would be to act as the Department of State, to whom all scientific societies would address themselves when matters affecting the public weal were brought before them.

It would be the link connecting Government with the world of science, a link which is non-existent at present, but which is much needed.

I trust that the facts I have placed before you show that the time ought to have arrived when something must be done to put these two public institutions on a proper footing worthy of the nation. Trade and industry, agriculture and health, are each and all dependent to a tangible extent on one or both of them.

I have perhaps strayed away from actual Society of Arts work too long, but the subject is one on which I feel strongly, but I must not conclude without a word or two on the present position of the Society of Arts. To-night's meeting marks the commencement of the 151st year of the Society's life. Its membership is now about 3,700, almost the highest number it has ever reached. The finances of the Society are on a sound footing, though the property of its own is but small, consisting as it does of such savings as have of recent years been set aside from current revenue. We have, however, to remember that the tenure of our present building may come to an end within a few years, when the need of providing a new home will be forced upon us, and this will no doubt be costly.

During the 150 years of its existence the Society has done much useful work, and none more useful than in the last few years. It occupies a position quite peculiar to itself, and is very wide in its aims. The King has recognised the part it plays and has played by remaining its President when he was Heir to the Throne, and continuing as its Patron at the present time.

We have as our President the Prince of Wales, and he has shown his interest in various ways in its welfare. I should like to see, in the fourth half century of its existence, the patronage which has been so graciously extended to it made patent by a prefix which would indicate it. Whether or not, the Society, I have no doubt, will play the same useful part in the coming fifty years as it has in the past, and I trust this year may be a year when it will have increased energy and vigour, and will at its close show that it has fully maintained its old prestige, of which we members are so justly proud.

After delivering the Address the Chairman presented the Society's medals which were awarded for papers read during last Session.

At the Ordinary Meetings:—

Sir Charles Malcolm Kennedy, K.C.M.G., C.B., "The Fiscal Problem."

Arthur Gulston, "Ice Breakers and their Services."

Robert Jones, M.D., B.S., M.R.C.P., F.R.C.S., "Physical and Mental Degeneration."

J. C. Medd, "Agricultural Education."

Thomas Tyrer, F.I.C., F.C.S., "The Need of Duty-free Spirit for Industrial Purposes."

William Pollard Digby, "Statistics of the World's Iron and Steel Industries."

Richard R. Holmes, C.V.O., "Early Painting in Miniature."

In the Indian Section:—

J. M. Maclean, "India's Place in an Imperial Federation."

Frank Birdwood, B.A., "China Grass: its Past, Present, and Future."

In the Colonial Section:—

Lady Lugard (Miss Flora L. Shaw), "Nigeria."

Alfred Emmott, M.P., "Cotton Growing in the British Empire."

In the Applied Art Section:—

Frank Warner, "The British Silk Industry."

Alfred East, A.R.A., "The Sentiment of Decoration."

Alan S. Cole, C.B., "Recent Developments in Devonshire Lace-making."

Sir STEUART BAYLEY, K.C.S.I., in proposing a vote of thanks to the Chairman for his interesting and valuable address, said he was not so sanguine as to believe that a Government of either party would be willing to enter the net which he had placed in sight of the wary bird, but if they would listen to the words of wisdom which had been uttered, they would be doing the country one of the greatest possible services.

Sir CHARLES KENNEDY, K.C.M.G., C.B., seconded the resolution, which was carried unanimously.

The CHAIRMAN acknowledged the compliment, and the meeting terminated.

MISCELLANEOUS.

CHEMICAL CONGRESS, LIÈGE, 1905.

Among the congresses arranged in connection with the Liège International Exhibition of next year, and with which the co-operation of the Belgian Government is ensured, that on Chemistry and Pharmacy, convoked by the Belgian Chemical Society and the Liège Pharmaceutical Association, is to be held at the end of July, 1905. It will promote a preliminary debate of the questions already submitted by the Berlin Congress of Applied Chemistry, 1903, to the deliberations of that to be held at Rome in 1906, and the decisions of the Liège Congress will be presented to the latter as national desiderata, while other questions raised by competent societies will be discussed and then referred to future congresses.

The Liège Congress is to be divided into the following sections:—1. General chemistry, physico chemistry; 2. Analytical chemistry, apparatus and instruments; 3. Industrial mineral chemistry, including metallurgy and industrial organic chemistry (sugar-boiling, fermentation, tanning, dyeing, &c.); 5. Pharmaceutical chemistry; 6. The chemistry of food substances; 7. Agricultural chemistry, manures; 8. Biological and physiological chemistry (application to hygiene and bacteriology); 9. Toxicology; 10. Practical pharmacy; and 11. Legislation and professional interests, deonthology.

The president of the organising committee is Prof. A. Gilkinct, of Liège, and the vice-presidents, Prof. L. Crismer and M. A. Delante. Further information can be obtained on applying to one of the secretaries—M. J. Raymond, 16, Place des Carmes, Liège, and M. J. Wauters, 83, Rue Souveraine, Brussels.

COAL IN THE SOUTH-EAST OF ENGLAND.

From circulars just issued by the Consolidated Kent Collieries Corporation, Ltd., it appears that the natural obstacles inherent to the piercing the water-bearing strata overlying this coalfield have been overcome, and a pitshaft sunk through from the surface to the coal seams.

The Kindt-Chaudron method by which the work has been accomplished is a Belgian process, first introduced into this country at the Cannock and Huntingdon Colliery (an extension of the Cannock Chase Coalfield) by Mr. F. W. North, a member of the Society of Arts, who was the consulting engineer for that enterprise, and was afterwards adopted by Mr. John Daglish at the Witburn Collieries, near the coast at South Shields. It reverses the usual process of sinking pit shafts by employing the labour at the surface instead of the bottom of the pit, and after having excavated the circular shaft to any reasonable depth by means of huge boring tackle, fitting it with cast iron cylinders to hermerically seal back all water by the compression of the Moss Box Gland, a unique part of the invention, without any labour being used below surface level.

The circular alluded to states that 1,100 feet in length of these cast iron cylinders weighing 4,000 tons have been successfully lowered into the pit which is now lined with this enormous iron cylinder. The usual tests having been applied, it is found to have effectually cut off the water bearing beds, so that it is now possible to proceed with the sinking of the working shaft without any trouble from water.

OBITUARY.

WILLIAM SAMUEL TROUNCE AND WILLIAM JOHN TROUNCE.—During the last week the Society of Arts has suffered a severe loss by the sudden death of the two chief members of the firm of William Trounce, printers to the Society for over fifty years. Mr. William Trounce, father of Mr. William Samuel Trounce, undertook the printing of the *Journal* in 1853, commencing with the first number of the second volume, and since he died, about thirty years ago, the work has been carried on by his son and grandson, both of whom have now died within a few hours of each other. The firm was originally established in Cursitor-street, Chancery-lane, and it was through the reputation they had obtained as law printers that they first became known to Mr. Peter Le Neve Foster, the Secretary of the Society of Arts in 1853. To a large extent, in consequence of their connection with the Society, the business developed, and in the seventies it moved to Gough-square, Fleet-street, where its offices have since remained. On the death of the founder of the firm, the control of the business passed into the hands of William Samuel Trounce, but he soon relinquished the actual management of that department connected with the Society of Arts to his son, William John Trounce, who carried it on till the day of his death. On Friday morning, 11th inst., he died suddenly from an apoplectic seizure, in

the thirty-eighth year of his age, having left his business on the previous night apparently in his usual health. On the following Monday night, the 14th inst., his father, Mr. W. S. Trounce, the head of the firm, also died suddenly, at the age of sixty-four, from heart failure, caused by grief at the loss of a son in whom he felt great pride, a pride amply justified by that son's great business capacity, courtesy and constant endeavour to carry out the wishes of those by whom he was employed. Mr. Trounce senior had for several years suffered from an affection of the eyes that necessitated his leaving the chief charge of the business in the competent hands of his son.

GENERAL NOTES.

COACHBUILDING PRIZES.—The Company of Coach Makers and Coach-harness Makers of London offer the following prizes for competition among British subjects engaged in the trades of coach making and coach-harness making and accessory trades, and members of drawing and technical classes in connection with such trades, resident in the United Kingdom of Great Britain and Ireland. Competition No. 1 (open to teachers of technical classes and previous prize winners in the company's competitions)—For drawings of a sound strong jobmaster's "Char-a-banc," to seat twenty passengers inside, safe and easy access behind; scale 4 inches to the foot; 1st prize, the Company's silver medal and £5 5s.; 2nd prize, the Company's bronze medal and £2 2s. Competition No. 2 (open to all, except teachers and previous prize winners in the Company's competitions)—For a drawing of a small light omnibus, to seat six persons inside, allowing 16 inches for each person (measuring the front of each seat); scale 4 inches to the foot; on paper 6 feet by 4 feet 6 inches; 1st prize, £5 5s.; 2nd prize, £2 2s.; 3rd prize, £1 1. Competition No. 3 (open to all)—For side view, plan and section drawings to full working size (coloured) of all the metal-work, exclusive of wheels, axles and springs, of an ordinary one-horse landau; 1st prize, £3 3s.; 2nd prize, £1 1s. Competition No. 4 (confined to coach trimmers)—For the best made pair of spring cushions for a brougham, any size, but the depth not to exceed six inches, the springs not necessarily steel. All other points of merit being equal, preference will be given to the shallowest in depth; scale 3 inches to the foot; 1st prize, £5 5s.; 2nd prize, £2 2s.; it is hoped that employers will assist by lending the necessary materials. Competition No. 5 (open to all)—The Master, Sir Alfred Seale Haslam, M.P., offers £10 10s., and the Company offer a silver and bronze medal and £5 5s., for a design for a complete motor-car to carry two people in the hind part and two on the driver's seat, including the chauffeur; the hind part to be convertible from an open to a closed carriage; side view and half plan; scale 3 inches to the foot; 1st prize, the Company's silver medal and £10 10s.; 2nd prize, the Company's bronze medal and £5 5s. Competition No. 6 (open to those under 18 years of age who have never won a prize in the Company's competitions)—For drawings in ink of a T cart, side view; 1st prize, £2 2s.; 2nd prize, £1 1s. The above prizes will be accompanied by the certificate of the Company.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 21...Geographical, University of London Burlington-gardens, W., 8½ p.m. Dr. Hunter Workman, "Explorations in the Western Himalayas."

British Architects, 9, Conduit-street, W., 8 p.m. 1. Mr. L. G. Mouchel, "Monolithic Construction in Hennebique Ferro-Concrete." 2. Mr. W. Dunn, "Construction and Strength of Reinforced Concrete."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. E. Burton-Brown, "Recent Excavations in the Roman Forum."

TUESDAY, Nov. 22...United Service Institution, Whitehall, S.W., 3 p.m. Colonel G. E. Gouraud, "The First Regiment of Volunteer Cavalry, U.S.A., in the War of Secession, 1861-65; how, when and where raised, and some of its doings."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. J. F. Cleverton Snell, "Distribution of Electrical Energy."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. W. Staley Spark, "The Wealth of Canada as an Agricultural Country."

WEDNESDAY, Nov. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. B. H. Morgan, "The Systematic Promotion of British Trade."

Geological, Burlington-house, W., 8 p.m.

The Faraday Society, 92, Victoria-street, S.W., 8 p.m. 1. Professor L. Kahlenberg, "Recent Investigations Bearing on the Theory of Electrolytic Dissociation." 2. Mr. F. J. Brislee, "The Potential of the Hydrogen—Oxygen Cell."

Royal Society of Literature, 20, Hanover square, W., 8½ p.m.

THURSDAY, Nov. 24...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. M. N. Drucquer, "Law and Custom of the Stock Exchange."

United Service Institute, Whitehall, S.W., 3 p.m. Lt.-Col. C. B. Mayne, "The Lance as a Cavalry Weapon."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m.

FRIDAY, Nov. 25...Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Messrs. J. T. Micklethwaite and E. Prioleau Warren, "Excavations in Westminster."

Clinical, 20, Hanover square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, Nov. 26...Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, NOVEMBER 28, 8 p.m. (Cantor Lecture.) D. J. BLAIKLEY, "Musical Wind Instruments." (Lecture I.)

WEDNESDAY, NOVEMBER 30, 8 p.m. (Ordinary Meeting.) ARTHUR LEE, "The British Canals Problem."

Further details of the Society's meetings will be found at the end of this number.

COLONIAL SECTION COMMITTEE.

A meeting of the committee of the Colonial Section was held on Wednesday afternoon, 23rd inst. Present:—SIR WESTBY B. PERCEVAL, K.C.M.G., in the chair, Mr. Carmichael Thomas, Sir Frederick Young, K.C.M.G., with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section. The arrangements for the new session were considered.

THE LATE SIR FREDERICK BRAMWELL.

Mr. H. Graham Harris, lately a Vice-President of the Society, and for many years Sir Frederick Bramwell's partner, has presented to the Society a portrait of Sir Frederick, specially painted for the purpose by Mr. Seymour Lucas, R.A. The portrait was a posthumous one, and consequently could only be executed from such materials as could be supplied in the way of photographs, painted portraits, &c.; but, nevertheless, it is in the opinion of all who have seen it, an excellent likeness as well as an admirable work of art. In accepting it, the Council passed the following resolution:—

Resolved that the Council have much pleasure in accepting the liberal offer of Mr. Henry Graham Harris to present to the Society a portrait of the late Sir Frederick Bramwell, specially painted for the purpose by Mr. Seymour Lucas, R.A. In thanking Mr. Harris for the gift, they desire to express their admiration of the portrait and their satisfaction that the Society should possess a permanent memorial of one who was so closely associated with its work during a period of 30 years, and was so highly esteemed and regarded as Sir Frederick Bramwell.

ST. LOUIS EXHIBITION.

LIST OF AWARDS TO MEMBERS OF THE SOCIETY OF ARTS.

The following is additional to the list in the last two numbers of the *Journal*:—

Everett, Edgcumbe & Co. (Kenelm Edgcumbe), Gold Medal.

NORTH LONDON EXHIBITION TRUST.

In 1865, the Committee of the North London Working-classes and Industrial Exhibition (1864), presented to the Society of Arts a sum of £157, the balance of the surplus from that Exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art Workmanship Competitions were discontinued after 1870, but since that date various prizes have been awarded under this Trust. Last year, prizes were offered to the students of the Artistic Crafts Department of the

Northampton Institute, Clerkenwell, and these have been awarded as follows :—

1st prize (£7 7s.), to Edgard Alfred Hatfull.
2nd prize (£4 4s.), to Lewis Edwin Stanton.
3rd prize (£3 3s.), to Edward Cockren.

THE BRITISH SCIENCE GUILD.

Under the above title an organisation has recently been established, the objects of which are briefly: (1) To enforce the necessity of applying scientific method to all branches of human endeavour, (2) to bring before the Government the scientific aspects of all matters affecting the national welfare, (3) to promote and extend the application of scientific principles, and (4) to promote scientific education. Sir Norman Lockyer is President of the Organising Committee, Lord Avebury the Treasurer, and Lady Lockyer the Honorary Assistant Treasurer. The Guild has already been joined by a considerable number of Fellows of the Royal Society and other influential persons, and its Committee have requested the Council of the Society to bring it under the notice of the members of the Society of Arts. The Council are in sympathy with the objects of the Guild, and they think it possible that some members of the Society may welcome the opportunity of associating themselves with it. They have therefore authorised the Secretary to receive the names of any members of the Society who may desire to join the Guild. The contribution required from subscribers is merely nominal, 2s. 6d. per annum, with an entrance fee of like amount. Further information as to its aims, objects, and organisation, can be obtained on application to the Honorary Secretary of the Guild, Mr. C. Cuthbertson, 9, York-terrace, London, S.W.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 23, 1904; SIR JOHN ALEXANDER COCKBURN, K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Heraje, Pandoorung, Agar Bazar, Dadar, Bombay, India.
Hnyin, Tha, B.A., F.C.S., 13, Ladbroke-road, W.
Ince, Robert Self, 24, Deerbrook-road, Herne-hill, S.E.
Jagonnath, Ganpat, Lady Jumshedjee-road, Dadar, Bombay, India.
Jordan, Albert Edward, A.M.I.Mech.E., 6, High-road, Nungumbaukum, Madras, India.
Moorcroft, Harold, Marsh-parade, Wolstanton, Staffs.
Townsend, W. G. Paulson, 12, Clifford's-inn, Fleet-street, E.C.
Wheatley, William Humphrey, 40, Chancery-lane, W.C.

The CHAIRMAN, in introducing the lecturer, said that figures could be made to prove almost anything, but no figures could cover up the fact that England was not keeping its colonial trade. They must admit, to a certain extent, that they had been spoilt by their prosperity, and, by going to sleep had allowed others to steal a march upon them, but they could not shut their eyes to the fact that the rivals who were competing for colonial trade were not nations that they could afford to trifle with. Those nations were highly organised, and in these days of organisation, when every move should lead towards efficiency, it would be just as reasonable to oppose a Noah's Ark to a modern warship as it would be to expect an unorganised mass to compete successfully with nations who had organised their trade to the highest point of efficiency. The doctrine and practice of *laissez faire* were all very well when a nation had no competitors on its heels; but when others were coming close after it was necessary to turn on a full head of steam again. There was a squabble about all sorts of doctrines; professors and public men were perpetually wrangling over what ought to be done according to eternal principles, while the ship of commerce was sinking under their feet. That position of things wes too serious to be dealt with in a light way, because anything which affected trade affected the livelihood, the health, and the very lives of the citizens of a nation. He often wondered what any of the other great nations of the world, who understood the value of organisation, would do if they only had the chance of the mother country had with the trade of her colonies. Even if they had the shortly-coming reform in the fiscal system, other things would also be needful in order to re-establish English pre-eminence in the industrial and commercial world, and anything that awoke the intelligence of the people and made them think, would bring the advent of that needful step nearer every day.

The paper read was—

THE SYSTEMATIC PROMOTION OF BRITISH TRADE.

By Ben H. Morgan.

For a long time past an ever-recurring question on exchanges, in merchants' and manufacturers' offices, in all gatherings of men of business, has been this:—Is it well with British trade? And the answer—No one can pretend that it is satisfactory. I am not going to weary you with a long array of figures. Statistics have been accused of being used to prove anything, and I am afraid there is some truth in the charge. Figures certainly lend themselves to some manipulation, but facts are and will ever remain stubborn things, The broad facts of our present day trade in the Colonies and abroad, are marked plain in the statistical abstracts of our Board of Trade, and those facts cannot be altered by any amount of special pleading.

The total import trade of British colonies and possessions, as stated by the Board of Trade during the year 1888, amounted to £171,462,000, excluding the inter-state trade of the Australian colonies which, even then, was considerable. The share of this trade that fell fifteen years ago to the United Kingdom, was £100,576,000, as compared with £46,336,000 from foreign countries, and £24,550,000 from other British colonies. Well, in 1902, the last year dealt with in the official statistical abstract of colonial trade, the total volume of trade with these same colonies and dependencies had grown to £276,900,000. But of the enormous expansion of about 105½ millions that these fifteen years had witnessed, only about one-third fell to our share. The colonial portion of this trade had more than doubled, £24,550,000 being converted into £54,000,000; the expansion of that particular item no one in this room will grudge, I am sure. It is impossible, however, for a patriotic Englishman not to feel some uneasiness as he notes that the share of this colossal trade, taken by foreign countries, was no less than £89,900,000. In other words, while in fifteen years the importing capacity of the British colonial market has enormously increased, the share of that increase that fell to the United Kingdom amounted to barely one-third, whereas the exports of our foreign competitors had nearly doubled. Making all possible allowances for the imports into our Colonies of commodities which we cannot raise or economically produce in the United Kingdom, this balance-sheet cannot be viewed with any satisfaction. Broadly speaking, these foreign imports into the Colonies represent at least £25,000,000 to £30,000,000 of trade which should go to British manufacturers.

A statement of the import trade of the British self-governing colonies is no more comforting. According to the Board of Trade, the value of the latest imports of goods from all sources into the self-governing colonies is £113,000,000, of which £55,000,000 is the share of the United Kingdom, £47,000,000 that of foreign countries, and £11,000,000 the quota of British possessions. In the case of Australia, British exports in the last decade have actually dropped from £26,000,000 to £23,000,000, while the trade of foreign countries has risen from £6,000,000 to £11,000,000. Clearly there is something wrong about our export trade with the colonies. It must be remembered that these colonies are our natural markets, and any considerable diversion of trade from our own manufacturers, besides being an intrinsic loss, must necessarily result in a weakening of the ties that unite the colonies with the mother country.

I do not propose to give any statistics to show the condition in which our own export trade with foreign countries at present stands. An examination of such figures would, as we all know, reveal a still more unsatisfactory state of things.

It is only too plain that our export trade has not expanded, either in the Colonies or in foreign countries, in proper proportion to the expansion of the world's volume of commerce. In other words we are not getting our fair share of the world's trade, and I am afraid it is true that a very large body of trade has been and is being lost to us through causes which are entirely preventable.

What are those causes? I will say at once that I am not about to enter, in any shape or form, on matters fiscal. The great controversy between free trade and protection, which has raged in most civilised lands for some two centuries, and will, perhaps, two centuries hence, be as far from settlement as it is to-day, has indeed been lately raised in this country in an acute form. But at present this is essentially a political controversy, and with politics I am in no way concerned. The great issues involved in the question of colonial preference and of fiscal policy in general, can only be settled at the polling booths, and will, perhaps, not be finally settled till two or more general elections have passed

over our heads. Until, therefore, the country has definitely pronounced itself upon this point, it would be futile to drag fiscal questions into such a paper as this.

Moreover, whether we remain free traders or revert to protection, the expansion of our trade either in the Colonies or in foreign lands, must to a great extent depend on the energy displayed by our manufacturers and traders, on their technical proficiency, which will itself depend to a great extent on their technical training, on their ability to adapt themselves to the ever-changing conditions of foreign and colonial demand, and last, but by no means least, on the direction and organisation of our industrial and commercial forces by the State. Lord Macaulay, in one of his inimitable essays, remarked it was highly probable that the highest and lowest Churchmen, though hopelessly apart on the proper ritual for the Church of England, would be in perfect agreement as to any two sides of a triangle being together greater than the third side. In the same way, I should imagine that the most ardent free trader and the most convinced tariff reformer would agree that colonial and foreign trade is not to be captured by antiquated methods of commerce, by shutting our eyes to what is going on in the world around us, or by that sleepy indifference on the part of the State to the trade interests of the country which used to be known under the title of *laissez faire*.

The State and Trade.

There are still many traders, thoughtful men of business, who are not alive to the responsibilities of the State in regard to trade. Too many people seem to take it for granted that because the State interfered unwisely with trade in days gone by, therefore all Governmental action in regard to the body industrial and commercial is to be deprecated. It has been truly said that the edict of no Czar can call into being a Birmingham or a Manchester. But that is no excuse for leaving undone what may conduce to the building up of trade and commerce. Moreover, those who argue that the State has no right to interfere with the course of trade forget that the business of the country is interfered with in a hundred ways by the direct action of the State. What are factory acts, workmen's compensation acts, shipping legislation, adulteration laws, and so forth, but direct interference with the course of trade. It may be said that the activity of the State in this direction is called for by the highest interests of the commonwealth. That is doubtless quite true, but if the Government may legitimately impose restrictions that in certain cases hamper our commerce in competing for foreign trade, why is it not equally bound to promote trade, when such action can be taken at a reasonable expenditure of public funds, and above all with a maximum of useful effect? By this I mean that in promoting the interests of traders the State should act strictly on the principle of the greatest good of the greatest number. The bearing of this remark will be made clear by the consideration, in the course of this paper, of what the State may fairly be asked to do to assist manufacturers and traders in placing their goods in Colonial and foreign markets.

The Control of Shipping Monopolies.

We will, first of all, see what the State has done and might do in regulating the carriage of goods between this country and its Colonies. Here, it must be confessed, the State, as represented by the War Office, the Colonial Office, and the Crown Agents, has done less than its duty. Take the classic instance of the South African shipping ring. The creation of monopolies by the State may no doubt be justified in many cases by the end in view; railways, gas and water companies, harbour boards and similar bodies are monopolies created by the State; such bodies are granted certain privileges in return for specified services, but at the same time their powers are carefully and rightly controlled by the State. Why then should not the same control be exercised over such a body as the South African shipping ring or conference, if that name be preferred? It may be said that the conference was not called into being by Act of Parliament. Nevertheless this powerful body, which by its action has done so much to divert British trade in South Africa into foreign hands, was called into life, or rather endowed with its present vitality and power by the action of the British Government. It was the contracts placed in the way of the shipping conference which armed it with powers to oppress the private and especially the smaller trader. Who placed those contracts, but the War Office, the Colonial Office, and the Crown Agents? Was it equitable then to allow this powerful body, armed by the State with a virtual monopoly, to cripple British trade with South Africa by levying carriage rates that were in many instances extortionate? Further, to rivet those rates, so to speak, through the so-called rebate system, which is

nothing more nor less than caution-money levied on shippers to ensure their continued submission to the yoke of the conference? The whole conduct of this ring has been designed to coerce British manufacturers, merchants and shippers, into paying rates, that in many instances made competition hopeless against American goods. The difference of freight to South Africa in favour of the New York shippers has, in many cases, been equal to a working profit on some classes of goods, notably hardware.

The pernicious effect on the expansion of British trade in South Africa of this shipping ring has been fully recognised in the resolutions at the recent conference of South African Governments at Cape Town. Most explicitly was the condemnation passed on the methods of the ring as unjustly favouring foreign shippers and placing small traders at a serious disadvantage as compared with public bodies such as Government departments and powerful shippers in general. The recommendations of this conference are drastic, and would no doubt be calculated, if put into effect, to abate the serious evils against which they are directed. But is it not remarkable that it should have been left to these colonies themselves to denounce officially the excesses of an ill-restrained monopoly which owes its birth to the fostering care of the mother-country! True it is that the home Government was represented at this conference, but the whole movement was essentially colonial, though very likely the agitation set on foot in this country contributed an appreciable share to the result. In considering, however, the true functions of the State as regards the promotion of industrial activity and the expansion of British trade, it is impossible to forget the extraordinary attitude last session of the Colonial Office during the scathing exposure of the shipping ring's methods and policy in the House of Lords by Lord Portsmouth and Earl Grey. The Duke of Marlborough, who represents the Colonial Office in the House of Lords, whitewashed the ring and calmly put aside all suggestions for reform. Yet less than three months later, a conference of all the South African colonies (including Rhodesia) solemnly condemned the system which the Under-Secretary of State for the Colonies had defended in the Imperial Parliament. In some respects, I must say it, our colonial brothers have a truer conception of the duty of the State towards the trading community than exists in this country. Very possibly this feature of colonial life was in the mind of the Prince of Wales when almost in stepping off the good ship *Ophir*, he gave utterance to the words, "Wake up, England!"

British trade with Australia is hampered by being in the hands of a somewhat similarly organised shipping monopoly to that of South Africa. American traders can send their goods to this market at about 12s. 6d. per ton less than we can. Little wonder is it that our trade with this part of the Empire is actually decreasing.

It can hardly be contended that it is not the function of Governments to supervise and control, if need be, the action of trusts and all combinations of this character. That free competition is a better regulator of prices than any Government official is beyond contention, but the essence of a trust is to abolish competition by the creation of a monopoly. Now it cannot too urgently be impressed upon the public conscience, that it is the duty of the State, which is only the guardian of the common weal, to keep a watchful eye on all monopolies, whether created by its own act, either in whole or part, as is the case with a gas company and the shipping ring, or brought into being by the spontaneous action of capitalists, as in the case of the Australian and African meat trusts.

The State as a Lighthouse to Traders.

If there is one point more than another in which the Colonies give the motherland a lead, it is in regard to the fostering care which the State almost invariably extends to industry and commerce. Whoever heard of a British public department troubling its head about the representation of home industry at great international exhibitions? It is true grants are made now and again on such occasions, but only on such a meagre scale as to excite the derision of visitors to the show, thereby defeating their object. Very differently do the Colonies in these matters. Canada has a permanent Exhibition Committee, which consists of experts and linguists capable of effective work in almost any civilised land. The result is that the Dominion is properly and efficiently represented on every suitable occasion. As an instance of the careful attention which the Dominion Government devotes to the expansion of its export trade, it may be mentioned that refrigerator cars are provided on the Canadian Pacific Railway in which farmers and exporters can forward any perishable articles to the seaboard free of any extra charge.

In one respect in particular, the Colonies, one and all, set us an example that might, and indeed must be followed, if we are to keep our position among the great trading nations. There is no self-governing colony which, so far as I am aware, has not an Agent-General in London. Now these officials are very largely ambassadors of commerce; at any rate one of the most important duties attaching to their office is the collection and dissemination at home of information respecting the value of Great Britain as a market for the colony's produce and goods. Again, in South Africa, both Canada and New Zealand have located permanent trade commissioners. These are officials whose duties go beyond the mere transmission of general details concerning trade. They are furnished with offices and staffs capable of acting more or less as travellers for the trade of their colony.

If the Colonies, with their comparatively limited means, can do this useful work for the expansion of their trade, why cannot the British Government with its unequalled resources, give a mighty impetus to the expansion of British trade in the Colonies, and in foreign countries? The word Government is an elastic term. We will see how the State, merely by an intelligent use of its existing machinery, and by the expenditure of less than a tithe of the sum it annually devotes to the Army and Navy, could materially assist in the expansion of British trade throughout the Colonies and the whole world, for that matter. What are the public departments which may fairly be called on to assist in the development and expansion of British export trade? These are, I should say, the Foreign Office, the Colonial Office, and the Board of Trade.

Our Consular Service.

The Foreign Office is already doing, and has long been supposed to do, a certain amount of commercial intelligence work through its consular service. Unfortunately this work is done too often in a perfunctory and slip-shod, because general way. Commercial men who are seeking information respecting foreign markets, want exact news as to prices, freights, the needs and preferences of the district, the nature of the competition likely to be met with, and so on. Such information the typical consul is not able to furnish. To begin with what is a consul? In one of Lever's novels this query was answered by "an official who puts mutinous seamen in gaol." This definition was not quite comprehensive enough even in Lever's day, but it has still a great substratum of truth. It is to be feared that those who contend that the British consular service needs reorganising from one end to another, have a strong case. At the same time reformers of the consular service will have to bear in mind the very multifarious duties the British consul has to discharge, especially in the near and Far East.

If you look over the Foreign Office List you will find, among the names of consuls, and still more of vice-consuls, many with a foreign ring. The bulk of these officials are not British consuls in the proper sense of the word. They are chiefly local men, probably naturalised as British subjects, who discharge the duties of consul, vice-consul, consular agent, or what-not, for a nominal salary, or no salary at all. They are sometimes known as trading consuls; they supplement their salaries or no salaries, by trade, foregoing thereby, if I am not mistaken, any claim to a pension. No doubt most of these trading officials manage to make accounts balance on the right side, but is it reasonable to expect of them whole-hearted service to British trade? The trading consul is, in this age, an anachronism, and must be dispensed with, in any shape or form. Remember that it is on such men that the consul or consul-general has to depend for the substance of his periodical reports on the state of trade in his district. Are consular officials of this type likely to be the most suitable to promote the expansion of British trade?

It may be freely conceded that during the past ten years a great improvement has been effected in our consular reports, and I am afraid that many traders in this country do not sufficiently appreciate them even as they exist to-day. Though too frequently lacking in the precise details which are the breath of true commercial information, they often give particulars respecting local trade customs and the general trend of demand for manufactured articles which should be of some use.

In the main, however, our consular commercial reports do not compare favourably with those published in some other countries. Take the admirable publications of the United States' foreign department. An excellent feature in the commercial information system of the great Republic is the series of monographs periodically published respecting the condition abroad of any particular branch of industry.

I have just perused two such books. Neither is bulky; in each case a demy octavo volume of some 250 pages is packed with information gathered from all points of the compass. One volume is concerned with nuts and bolts, the other with drugs and patent medicines. The latter is a perfect mine of information respecting the laws of all countries, civilised and uncivilised, on the sale of medicine. The drugs most in demand in different lands are all set forth. This book was made up from consular reports, specially called for no doubt; the editing must have been a considerable work in itself, but the book contains information which no single firm could have gathered except at a prohibitive cost; even then the work would have occupied years to compile. We have no such publications in this country.

Another consular service which is admirably organised for the dissemination of commercial intelligence is the Austro-Hungarian. In the reports published may be found terse but lucid summaries of what lines of goods are in demand in particular markets; the qualities called for are always carefully distinguished, while some idea of ruling freights is given. The competition that may be expected from other lands is almost always laid out. More helpful guides to the export trade of the Austro-Hungarian Empire can hardly be imagined.

But while it is certain that our consular reports are very far from what they should be, and from what they must be made, no one who has had any experience of export work would be content with the collection of news solely through this source. Yet the Foreign Office could render great service in the direction indicated. To enter, however, into the larger question of how far it is desirable to convert our ambassadors into ambassadors of commerce when railways and great public works are in the air would perhaps be going too far on this occasion. Yet unless rumour is more than usually at fault, the German and Russian Ambassadors at Constantinople are as much concerned with the advancement of commercial as of political schemes; it has been credibly asserted that German consuls in the Levant act as efficient enquiry agents for German traders who are asked for credit by native dealers.

The Board of Trade.

The co-operation of the Colonial as well as of the Foreign Office should be enlisted in the cause of our export trade. But the public department which should serve to focus, as it were, all commercial information collected for the use of our export trade, and should act as the motive spring of our commercial news service, is the Board of Trade. There is something in a name after all, and such a title should stimulate the department that bears it to some serious effort on behalf of the trade of this country. The history of this department is typical of the growth of British institutions. The department dates from 1786; a mere enumeration of the designated members of the Board is a sufficient indication of the hazy conception of its task which the new department had to face. Among the original members were the Archbishop of Canterbury, the First Lord of the Treasury, the First Lord of the Admiralty, the Speaker of the House of Commons, and many other strangely assorted dignitaries. To this Board was to be referred "all matters relating to trade and foreign plantations." There is no record of the deliberations of this body, if ever it met. For one thing, the "plantations," or, at any rate, a goodly part of them, were careful to look after their own interests, and are known to-day as the United States. But the Board of Trade lived on, and as steam brought into being railways and steamships, some useful work was found for this department. It was however mainly of the policing order. To this day the greatest activity of the Board is displayed in the inspection of new rail and tramway tracks, in prosecuting shipowners who overload their vessels, in fining the owners of corroded boilers (when they explode), and in looking after weights and measures and bringing bankrupts to book. But under the pressure of public opinion the department has moved some way in the past quarter of a century. True the progress was slow. Long after the introduction of gas the then offices of this department were lighted by dimly flickering candles. Nowadays great improvements have been made in the plant and general equipment. The department is on the telephone, though it seems to need a great deal of "calling up." Whether the transformation of this Board into a Ministry of Commerce and Industry is desirable is perhaps for our purpose rather beside the mark. What it is well to bear in mind is the fact that already the Board of Trade have been furnished with a new limb. It was in May, 1900, that a commercial intelligence department was founded, and an advisory committee, consisting of eminent men, appointed to direct its work. But as ordnance

cannot be worked without powder, neither can the central commercial intelligence department of the British Empire accomplish much useful work on a grant in aid of £1,000 per annum, even when allotted for "five years certain." With these small means the advisory committee has already managed to do some good work, in South Africa, Persia, and Siberia, but to make this innovation more than a mere farce, £20,000 per annum at least must be expended.

TRADE COMMISSIONERS WANTED.

The true function of the Board of Trade, or whatever title this department may take, is to serve as a lighthouse or beacon to the traders of the whole British Empire. It should be the means of stimulating to useful work in the collection of commercial information the officials of such departments as the Indian Office, the Foreign Office, and the Colonial Office.

Over and above the work done by the Foreign Office staff, under the superintendence of the Board of Trade, special trade commissioners should be appointed by this department to reside in British self-governing colonies or in any land that may hold out special outlets for British export trade. Such commissioners should be men of commercial knowledge, and, if possible, trade experience. They should have some knowledge of modern engineering, because the development of our colonies is largely a matter of engineering. They should be instructed to keep themselves informed of all trade movements in their respective territories by constantly travelling about. They must also be furnished with an efficient staff of local correspondents; because our colonies—South Africa, for instance—are big, if sparsely populated countries. They should be capable of reporting fully on any business that may be going, and be instructed to use the cable in all cases of urgency. The important point is this, that the information, whether or however published, must be accessible to the smallest as well as to the largest firm in Great Britain. This is the worthy and indeed only course for a democratic State to pursue.

"Information and more information" is the cry of the manufacturer and trader of Great Britain. Comparatively few firms can afford to specially investigate the possibilities and peculiar needs of foreign markets at their own expense. There are hundreds of manufacturers now confining their attention almost solely to the home trade, who would soon develop an export business if such information as I have indicated were made accessible to them.

WHAT THE BRITISH MANUFACTURER HAS GOT TO DO.

I think I have given some idea of the cooperation which the State may be fairly asked to, and indeed must give, if this great industrial country is to hold its own in the struggle for the world's export trade. But the duty of the industrial community in this land, or rather of its chiefs, whether they employ one hundred or thousands of hands, is not less clear. They must, in the first place, keep on "ringing up" thepublic departments. The Government official is by training an unprogressive creature. Change is uncongenial to him. He lives, to a certain extent, in an unreal world. If the history of almost any reform or innovation in the public service were written, it would be found to have originated either in some irresistible clamour of public opinion, or more rarely in the bold initiation of some strong minister, who, seeing existing practice to be at fault, resolved to mend it in spite of all bureaucratic opposition. But it takes a very strong man to break through official tradition, and such ministers are born, like great generals, perhaps once in a century. On the other hand, public opinion, when once set in motion, is irresistible. True it is that such a consensus of opinion is very hard to organise, especially in questions of trade. Trade is a subject not always calculated to excite the wildest enthusiasm, but British men of business must remember that their interests are in this matter of colonial and foreign trade vitally touched. If they bring their full force to bear on the Government departments these offices will promptly yield.

THROUGH BOOKINGS WANTED.

The main point which the British manufacturer has carefully to keep in view is the absolute necessity of getting into immediate touch with his market whether it be in a British colony or a foreign land. The importance of this may be easily overlooked. It must be borne in mind that our most dangerous competitors in many colonial and foreign markets are the United States and Germany. How wantonly South African trade has been driven, so to speak, into American channels has

already been pointed out, but it would not do to overlook the fact that both of our great competitors have for some time adopted more scientific methods in pushing their trade abroad. In other words, by means of through bookings they have managed to get into direct touch with the foreign customer. Though the German merchant may not be able to get a better sea freight than his British competitor, he has this advantage over him, that the railways in his own land, which are all more or less under the control of the State, will quote him a better through rate to the port of shipment than the British manufacturer can usually obtain.

Transport is, after all, an item as essential to the cost of an article as labour or any other factor in the manufacturer's bill of costs. The shipper who can quote his oversea customer, the exact or even fairly approximate cost of delivery, is in a much better position than the man who is encumbered with forwarding agents, and is working, to a great extent, in the dark.

I am glad to say that in one direction a great step forward has already been taken. The Post Office, after a good deal of spurring on by British traders, has at length consented to institute the C.O.D. system with all British colonies. For many years it is understood, this system has been worked by the German Post Office, and with good results. The system is simplicity itself. A lady in Melbourne, for example, may take a fancy to a set of fish knives, as shown in an illustrated catalogue, dispatched from Sheffield. She has only to send a penny post card to the works in Sheffield, whereupon a neat package can be made up in a few minutes and committed to the care of the post, the ordinary parcels charge being of course paid by the sender. But there his work is done. The post delivers the knives and collects the money, without which of course the postman would not give up possession. The sender is freed from all trouble and expense or enquiries, which in a matter of this kind would simply stop business altogether. On the other hand what an extension of British trade with the Colonies may be promoted by this judicious step. Though it may be true that the best results cannot in many cases be attained by those who seek an oversea trade, even with British colonies, unless good travellers are employed, yet a great deal can be done by going directly to the consumer.

National Engineering and Trade Lectures.

I have already spoken of the importance of the State undertaking the supply of commercial information to the British manufacturer and trader as to the needs and capacities of markets, and I would also point out that it is almost equally important that we should make known to buyers all over the world what we have to sell and are capable of producing. When touring through America, and later on going through South Africa at the close of the war, I was astounded at the ignorance which prevailed in those countries as to the progress Great Britain has made in recent years in her manufactures and processes. So much has been said and written of the conservatism of British traders, the antiquated methods and obsolete machinery in our workshops, and so many alarmists' statements concerning the decadence of our industries have been made that our Colonies and foreign countries have been seriously impressed. We cannot deny that a few years ago we were, in many respects, behind the times and badly needed waking up. Hitherto our manufacturers have relied chiefly on the qualities of durability and excellence of workmanship to recommend their goods to buyers in markets outside of Great Britain. This was very good in its way until the pushful American came along with his low-priced article, his attractively designed advertisements and aggressive business methods. Something more is now needed. Great Britain has effected enormous improvements in her manufacturing and industrial methods in the last few years. New works have everywhere been laid out and old ones remodelled, with a view to economical manufacture and the easy handling of material. Huge quantities of obsolete machinery have been consigned to the scrap heap and replaced with those of modern design, and everywhere British firms have laid and are laying themselves out for the manufacture of machinery and goods in quantity and on standardised and specialised lines. When the British manufacturer made up his mind that something was wrong he did not lose much time—with a silent celerity, he has been engaged in pulling down and building up with that quiet determination to lead that never yet failed his countrymen.

It has impressed itself on my mind that these are facts which should be made known to the world in some special way. The means to wide publicity at the disposal of individual firms is necessarily limited. They can, of

course, advertise in journals, and in ordinary ways, and distribute catalogues broadcast, but it seems to me that something more is needed—something in the nature of a national vindication of the character of the British manufacturer and trader. And it was with this idea in my mind that I have devoted a great part of the past two years to the development of a plan for giving the world a true conception of British manufacturing and industrial progress.

In a few words, this plan is that lectures be prepared by the leading experts in various branches of engineering and manufacture, for reading before Chambers of Commerce, technical institutions, colleges and schools in colonial and foreign industrial centres, emphasising the progress made by Great Britain in the manufacture of all the classes of goods and machinery, and their novel points of design and utility. It will be a special feature that each lecture will be illustrated with lantern slide views, thus depicting the interesting points in the most graphic manner. This enterprise has been made possible by the generous co-operation of a number of the most eminent engineers and specialists in Great Britain, and I desire to take this opportunity of expressing my appreciation of their hearty co-operation with me in this work. We want to show to our colonial brethren that as a scientific manufacturer, the Mother Country is second to no country; that if some rivals have excelled in modern works and improved machinery, they will in turn excel with works still more modern and machinery still more improved.

I am glad to say that our Government departments have given this scheme their assistance, while the Agents-General of our colonies have, without exception, co-operated with me in arranging that lectures should be reproduced and delivered before audiences that will appreciate them in one and all of our colonies. Regarding these lectures as a means of educating manufacturers and engineers, the leading foreign Governments are facilitating their delivery in their principal industrial centres, and in several instances are introducing them into their schools.

In the course of the next twelve months the story of British manufacturing and industrial progress will be told to hundreds of audiences in colonial and foreign markets, and if its telling helps to maintain and expand British trade, the efforts of myself and colleagues will have been amply rewarded.

[A number of lantern slides, illustrating the subjects of some of the lectures referred to, were shown on the screen after the reading of the paper.]

DISCUSSION.

Mr. JOHN SAMSON said he was not competent to speak upon the question of trade with the colonies because he was connected solely with South America, in regard to which country he could speak with a considerable amount of experience. The author had started with a very commonly accepted theory, namely, that British manufacturers were anxious to do business. His experience was completely to the contrary. British manufacturers appeared to be absolutely indifferent as to whether they did business or not. He was director of a company which was engaged in extending trade in South America, and he was continually sending out letters to manufacturers offering business, and in many instances he had never even obtained a reply. If, on the contrary, he sent letters to continental houses he invariably received carefully prepared estimates. When people found themselves better served by foreign manufacturers than by English manufacturers they would go to the former. He alluded especially to rails and railway plant. He was told by an engineer in a very large way of business that he considered it a waste of time to ask for estimates in England; the manufacturers either took a very long time to answer, or quoted prices which were absolutely impossible. In the second place he found that very few English manufacturers sent out their catalogues in foreign languages, and in the country he was connected with, catalogues, in English only, were absolutely useless to his clients. The author had spoken of through bookings. It was almost impossible to get any English manufacturer to quote for free on board to so near a place as Antwerp, although they would quote free on board for Glasgow, Liverpool, or London. All these things went to show that manufacturers in this country were not keeping place with their rivals. The author said that the Government ought to do more to provide commercial intelligence. About the year 1898 Mr. Chamberlain took that line, and appointed a Commissioner to go to South America; he also asked a Chamber of Commerce to appoint another member to represent them, and it was very significant that the Chamber of Commerce declined to appoint any such representative, and, therefore, the Board of Trade representative went alone. The author made a point in saying that the Board of Trade and the Commercial Department of the Foreign Office did not provide commercial intelligence for the use of manufacturers, but he held that the Board of Trade and the Commercial Department of the Foreign Office did provide more commercial intelligence than there was demand for. Tenders were asked for particular goods and no answers were received.

The Commissioner sent to South America by the Board of Trade sent home a very long and detailed report, which he questioned if any manufacturer had ever read, or even asked for. It was true that consular reports were imperfect and published very late, but the experience of the publishers was that they had no circulation at all, except amongst journalists. At present the reports could not be sold in Leeds. The Commissioner also brought home with him a very large collection of samples, and it was announced in the newspapers that those samples were to be exhibited at the London Chamber of Commerce and at Whitehall; the samples were on exhibition for about twenty days, and only about twenty persons had signed the attendance-book when he visited the exhibition. If he went to a manufacturer and said he could give him information which would be of value to him, he was asked to state his business, and in most cases the manufacturers did not care to give an audience at all. Therefore he held that if England was losing her colonial trade it was because her rivals were doing better, and England deserved to lose her trade under those circumstances. The first thing to be done was to awaken anxiety amongst British manufacturers to get that information, because the remedy proposed by the author would be of no effect until British manufacturers were educated to take an interest in their business.

Mr. E. T. SCAMMELL agreed with the last speaker, that the British manufacturer needed waking up, and that no talk about fiscal or any other reform would take the place of the awakening which was essential if England was to hold her own in the march of the world. He knew something of the Australian colonies; and the merchants and manufacturers of this country did not appear to be willing to learn the lessons which were taught them both by Germans and Americans in regard to many of their business methods. If somethiug could be done in this country thoroughly to arouse the attention of manufacturers on the point, the business done not only with the Colonies, but with the world at large would be greatly increased. He was glad to hear that steps were being taken for the spreading of further information. The last speaker had a little misunderstood the author's plan, which was not so much the giving of information to the manufacturers in this country as the spreading of the information in the Colonies. But he thought the Government might do more in this country. Those who were present when Sir William Abney gave his address on the previous Wednesday, heard one or two most important particulars in reference to which the Government might aid the commercial and industrial enterprises of the nation. If lectures were given in the Colonies, it would help to remove the misapprehension that prevailed, that the British manufacturer was fast asleep, and British commerce would thereby benefit.

Mr. SAMUEL CHAPMAN stated that he had lived in the southern part of Mexico for a number of years, and had noticed that when opportunities were offered to British manufacturers, they did not always avail themselves of them. English trade had increased in Mexico in the last ten years by 74 per cent., while German trade increased during the same time 225 per cent. He remembered, on one occasion, a firm who desired to place a large order for sugar machinery with an English firm, but so much difficulty was experienced in getting anything like a favourable quotation that eventually the order went to Belgium, solely because the quotations given were not suitable for a country speaking a different language. On the other hand, a large Lancashire firm sent out a representative about nine years ago to fit up some machinery. It was expected that he would be away four months, but he had never been over to England during the nine years that had elapsed, having been constantly filled with orders during the whole time. That was an instance of what British manufacturers could do if they would only take the proper steps. It was not only a question of the language, but also of following the instructions of the purchaser. Instead of china, for instance, being packed as specified, in a particular case, it was packed in such a manner that when it was landed considerable damage was done to the consignment, with the result that no further business had been done between important firms in the South of Mexico and china makers in this country. Too little attention was paid in this country to educating young men in foreign languages; and it was also very desirable that manufacturers should be acquainted with the metric system, so as to use it alongside the present system, even although the metric system might not be adopted by the country.

Mr. WALTER REID adversely criticised the lantern slides which had been shown by the author, saying they were by no means up-to-date. If the saloon car shown were put side by side with some of the Pullman cars turned out in large numbers in the United States it could not possibly hold its own. A better illustration of the turbine steamers would have been one of the new boats being built by the Cunard Company, of which there was a beautiful model in the St. Louis Exhibition. The Forth Bridge was hardly a thing to show to people who must become customers, because there was only one such bridge in existance, and each engineer built his own bridge according to his own designs; a better illustration would have been the factory in which the steel was turned out to make the Forth bridge. Dynamos like those shown on the screen could be picked up on scrap-heaps in the United States. He was sorry to hear the author say that high-speed cylinder engines also represented the best practice nowadays, because hardly a dynamo now made in America could be found running with reciprocating engines; they were all turbines. The whole of the electricity at the St.

Louis Exhibition was produced by means of turbine engines, and no American engineer would dream of putting up large reciprocating engines nowadays for the production of electricity. He could not impress too strongly on the author, whose scheme of giving lectures he approved, that he should be extremely careful in the selection of the slides, otherwise they must do more harm than good. With regard to the action of the State in such matters, there was no doubt the Government could do a very great deal more than it did. One of the reasons why State inference had been less productive of good in Great Britain than in Germany and France was that the State in England did not consult the different classes of producers to the extent the State did, especially in Germany. Before the German Government undertook any legislation of an industrial character, it consulted the representatives of the Trade Guilds, and unless our Government did something of the kind, any steps taken must prove injurious rather than beneficial to the trading community.

Mr. W. RAVENSCROFT BETTELEY thought the author bit the nail on the head when he asserted that the manufacturer should place himself in touch with the dealer. He had had an experience of forty years as a merchant in South America. The majority of the catalogues which manufacturers sent to that country were put into the waste paper basket, because they were printed in the English language. If the English manufacturer would take the trouble his German, French and Spanish competitors took, and have the catalogue translated into the language of the country, his trade would largely increase. If an English manufacturer could not send out a competens traveller, his best plan was to appoint a good firm in the country, in touch with the people, as his agent, who would then obtain the necessary business. He was sorry to say that the English manufacturer was losing his trade in South America. Forty years ago it was an exceptional thing to see a German in Buenos Ayres, but to-day Germans were in the majority, simply because of the better business methods employed by them. If some means could be found to arouse the British manufacturer he might fill the important place he ought to occupy.

Mr. C. ALFRED SMITH thought that Mr. Reid was rather unfair in his criticism of the lantern slides. He had made the sweeping statement that the whole of the current generated at the St. Louis Exhibition was produced by means of steam turbines. He had been told by a gentleman who had visited the place that, although as in England, the steam turbine was going ahead for central station work, that statement was not correct. It was only within comparatively recent years that the turbine had been recognised as a success, and the reciprocating high speed engine, although it was being strongly competed with, was still in the front rank as an electrical generator. A great deal of discussion had taken place with regard to technical education, but only one university had taken the trouble to found a faculty of commerce, viz , Birmingham, at the initiative of Mr. Chamberlain. Hundreds of students went through engineering courses who were altogether unsuited by temperament to become expert engineers, but they would make fine agents, and it was sad to think that in almost all the colleges the students had no opportunities for learning the commercial side. The advantage of students learning foreign languages was not impressed upon them, and he thought something might be done by the Society of Arts in enforcing that need on the younger generation. The hope of the country laid largely with the coming generation, and if some of the energy that had been put in the last few years into the evening technical classes could be put into the University colleges, he believed the trade of the country would be greatly benefited.

The CHAIRMAN, in proposing a cordial vote of thanks to the author for his extremely valuable paper, said that in following the author's statements he noticed that the lectures were not only to be given for commercial purposes to commercial men, but were to be given for educational purposes to schools, and in that case it was well to show the progress that had been made by means of lantern slides, although of course those slides must be absolutely up to date. One of the opening sentences in the paper had particularly struck him, because it opened up a vista of the loss sustained when any considerable diversion of colonial trade, which naturally belonged to English manufacturers, took place. Any trade which could be legitimately carried on in this country and went from the Colonies to foreign countries was necessarily attended by a gradual estrangement from the Mother Country. Correspondence followed commercial relations; one of the partners of the firm paid a visit to the country with which the business was done; he formed relationships of all sorts, and it was almost impossible to say where the evil ended when once a diversion took place, from the natural channels of trade that ought to take place between the Colonies and the Mother Country.

The resolution of thanks to the author was then put, and carried unanimously.

Mr. WALTER REID said his statement that the whole of the current generated at the St. Louis Exhibition was produced by means of steam turbines, had been called in question by Mr. Smith. He had papers in his possession which proved that practically the whole of the current was generated by steam turbines, and he did not wish Mr. Smith' statement to go forth to the world uncontradicted.

Mr. MORGAN, in reply, said that the reciprocating engine was still in the front for powers up to 200 horse-power, turbines not being economical engines in small powers, except in one or two instances. The engines referred to by Mr. Reid were large ones of 500 horse-power and over. The engines he showed on the screen were only for very small powers. With regard to the up-to-dateness of the pictures, he thought they should be content to leave the selection of them to the lecturers, who were amongst the most eminent engineers and specialists in Great Britain, and included Sir William Preece and Mr. Swinburne, both of whom were past Presidents of the Institution of Electrical Engineers.

MISCELLANEOUS.

THE WORLD'S COTTON SUPPLY.

Nearly a hundred and fifty years ago the Society of Arts was moved to use its influence to encourage the growth of cotton within the Empire. In 1761, as now, "the scarcity and consequential high price of cotton was a great detriment to our manufactures," and the Society had seen specimens of cotton from Senagambia, which led it to believe that an adequate supply could be obtained from Africa. "The Society was informed this cotton could be collected in any quantities whatever, at a low price, perhaps not exceeding a penny per pound," and it was of the opinion that it was a matter of national moment to encourage the growth of cotton in the African colonies, and elsewhere within the Empire, therefore the Society offered (in 1760) the following premiums:—

"For the greatest quantity of clean merchantable cotton; the growth of any of His Majesty's settlements on the coast of Africa, imported by private adventurers into any of the ports of Great Britain in the year 1761, not less than two tons, a gold medal.

"For the second greatest quantity, not less than five tons, a silver medal.

"And the like premiums, on the same conditions, will be given in the year 1769."*

Now, under very different conditions, we have a recurrence of the scarcity. The supply has not kept pace with the demand. It is true there has been a very large increase in the production of cotton in the United States during the last 30 years. In 1875 the total American production was 4,632,313 bales, it now exceeds eleven million bales, but the exports have not, proportionately, increased. Of the 4,632,313 bales produced in 1875, 2,982,810 was exported, 1,649,503 sufficing to meet home requirements, whereas last year the home consumption had increased in round figures to 4,000,000 bales, and will, no doubt, go on increasing. When we turn to other sources of supply than American, we find exports practically stationary. Thus in the decades 1870-80, 1880-90, and 1890-1900, India produced an average of two, two-and-a-half, and two million bales, whilst her own requirements steadily, though not very rapidly, increased. In Egypt the production nearly doubled in the 30 years from 384,000 bales to 700,000, but Egypt only supplies a small proportion of the world's production, and Brazil, the only other considerable producer of cotton, fell away from 600,000 bales to 380,000 in the same period. Thus the world is as dependent to-day upon the United States for its cotton supplies as it was 30 years ago, whilst the European demand has enormously increased. In the seventies England took the bulk of American cotton. To day continental spinners take a third of the whole of the American cotton. Comparing the year ended 30th June, 1889, with the year ended 30th June, 1899, we find that the exports of cotton from the United States to Germany increased from 660,756 bales to 1,728,975 bales; to Austria-Hungary from 5,610 bales to 57,127; to France from 400,196 to 803,406; to Italy from 131,068 to 417,353; to Spain from 181,533 to 248,635; whilst the exports to the United Kingdom only grew from 2,940,800 to 3,609,444. And year by year the continental demand diverts a larger proportion of the American product from England.

It is impossible to exaggerate the gravity of the outlook as it affects this country. Great Britain is practically at the mercy of the United States, and the sufferings of industrial Lancashire during the American Civil War give us an inkling of what that may mean. Already, Lancashire has suffered seriously from the growth of the continental demand, coupled with the rapidly growing requirements of the American home market. In 1901 and 1902, many of our cotton mills were unable to run full time owing to the shortage of cotton. In 1903, most of the Lancashire mills ran short time for four months, and a conservative estimate puts the direct loss suffered last year by the spinners, manufacturers, and operators at £2,000,000, which takes no account of the losses consequently entailed upon merchants and others indirectly interested in the cotton trade. This year, most of the Lancashire mills have been compelled to run short time for eight months, which means immense loss in the productive and earning power of the most important of our manufacturing industries. How great it is may be understood when we say that an authoritative estimate of the loss that would be incurred if all the cotton mills of this country were running three-quarters time instead of full time, puts it at £300,000 a week, or at the rate of £15,000,000 per annum. No fewer than 10,000,000 of the population of the United Kingdom are, directly or indirectly, interested in the cotton industry; and it may be taken as certain that much of the general

* These particulars are taken from Dossie's "Memoirs of Agriculture," vol. 1, page 302.

stagnation of trade is due to shortage in recent years of the supplies of American cotton.

Those most directly interested in lessening our dependence upon America have been rather slow to move, but a beginning was made at Manchester on May 8th, 1902, when a meeting was held at the Albion Hotel in that city, under the auspices of Mr. Arthur Hutton, the President of the Manchester Chamber of Commerce. The Chambers of Commerce of London, Liverpool, and Oldham were represented at the meeting, together with the managing director of the British West African Steamship Line, Sir Alfred Jones, the Oldham Cottton Spinners' Association, the Manchester Cotton Spinners' Association, various other Associations of a similar character, from Blackburn and other Lancashire towns, cotton machinists, brokers, weavers, and manufacturers. The object of the meeting was to widen the area of cotton cultivation under the British flag, more especially in West Africa; and before the close of the proceedings a British Cotton Growing Association was formed, with a preliminary capital of £10,000 to be exclusively devoted to experimenting in West Africa and other over-sea provinces. This meeting was followed by another, held in Manchester in June, 1902, when it was decided to raise a guarantee fund of £50,000, to be spread over five years, and inquiries were commenced throughout those portions of the British Empire where the conditions as to possibilities of cotton growing are suitable. Experimental plantations were inaugurated, large quantities of seed were distributed, ginning and baling machinery was sent out, advances were made to planters, and grants were made to various colonies. But £50,000 was very insufficient if the intentions of the Association were to be carried into effect, and so we find it in October, 1903, making arrangements to increase the guarantee fund to £100,000. It was, however, soon seen and admitted that even this larger sum was very inadequate to the requirements of the Association, and it was decided to increase the fund to £500,000, and to petition the King to grant a Royal Charter of Incorporation to the Association. In August last this charter was granted and the British Cotton Growing Association was thereby incorporated. The Association is already actively at work in various parts of the Empire, and the Government are cordially co-operating in the work. An arrangement has been entered into with the Secretary of State for the Colonies whereby in consideration of the work that is being carried on by the Association the Governments of Lagos, Northern Nigeria, and Sierra Leone will, during the ensuing three years, make grants to the Association amounting to £6,500 per annum. Several of the large steamship companies, too, are at present lending their assistance towards the extension of cotton cultivation by carrying freight free or at nominal rates. The Association is now seeking to raise the balance of its share capital. Of the £500,000, £125,332 has already been applied for and allotted, and it is expected that the public will find the balance required. It is not an ordinary investment to which the public are invited to subscribe for the Association may not declare any dividend, or distribute any profits before the expiration of seven years from the date of the Charter, and, in the meantime, any profits are to be applied in the furtherance and extension of the objects of the Association. It is in every sense a national undertaking deserving the support of all interested in the welfare of the United Kingdom.

The capability of the world to provide in sufficient abundance the raw material required by the vast and ever-increasing cotton industry is unquestionable, and cotton of the best quality can be got outside America. What is now known as Sea Island cotton is a native of Honduras. It spread thence to the West Indies, and was carried to the United States shortly after the Revolution. No finer cotton has ever been grown than that raised in the island of Tobago, between the years 1789 and 1792, upon the estate of Mr. Robley; and Egypt has furnished a staple which for quality and length holds a high rank, and comes next to Sea Island. It is not, perhaps, too much to say that Egypt is the finest cotton-growing country in the world, unsurpassed in productiveness even by the United States of America. In South America the cotton plant thrives in all the varied climates from Para in the North down to Rio Grande in the South. In India the quantity available for export can be increased, and although India does not grow the highest quality, the addition will help to lessen the dependence upon America. As for West Africa it is capable of producing more than the present world's supply. Already the cotton industry plays an important part in the prosperity of Kano and Northern Nigeria generally. The cotton plant is met with in a wild state all over West Africa, and the pagan tribes of Sierra Leone, the Gold Coast, and Liberia turn out the most beautiful cloths. Mr. Hutton expects that in the next five years we shall get a million bales from West Africa. From Lagos, it is estimated that from 6,000 to 10,000 bales will be obtained next year, as compared with 2,000 bales last year, whilst in East Africa the outlook is very promising. In Nyassaland alone, considerable quantities of cotton, equal to "Good Fair" Egyptian, can be produced, and should the steps that are being taken to establish cotton growing as a native industry prove successful, then larger results will be obtained. So with the West Indies and British Guiana, advances have been made by the Association to cotton growers, and seed, machines, and implements supplied. The finest qualities of cotton have been obtained from the Sea Island seed, and the industry is now in many districts established on a commercial basis.

The difficulty is not in the growing of cotton, but in its profitable cultivation. The four things requisite for successful cultivation are (1) a suitable soil; (2)

a regularly recurring rainfall and adequate irrigation; (3) sufficient labour; (4) transport facilities. Lack of labour and cheap transport are the chief difficulties, and at present, and in some countries, they are insuperable. And of course much depends upon the price. The German experiments at Togo are very encouraging. There the one thing necessary to complete financial success is adequate transport facilities. The use of improved implements, the introduction of better methods of cultivation, and a more economical system of labour have lessened the cost of cotton production, and having regard to the many countries that may be expected under the present more favourable circumstances to contribute to the cotton supply of the world, it is reasonable to assume that the cotton industry will soon be on a sounder footing than it can ever be under present conditions. The work of the British Cotton Growing Association bids fair to have a great and beneficial influence in rescuing us from our perilous dependence on America, and so deserves the good wishes, and national support, of all sections of the community.

Since the above article was in type, the Paris correspondent of the *Times*, under date November 21, has sent the following important statement to his journal:—

M. Méline, the ex-Premier, makes an interesting contribution to the pressing problem of the emancipation of European industry from the American cotton monopoly in to-day's issue of the *République Française*, taking as his text the incorporation of the British Cotton Growing Association. He represents the cultivation of cotton in the French and English colonies as being the sole means of averting a repetition of the recent threat of a cotton famine, which disturbed the entire industry throughout Europe, and of meeting the approaching peril arising from the steadily increasing absorption of the cotton supply by the growing industry of the United States. If America be allowed to retain her present monopoly of the raw material, M. Méline does not see how she can be prevented one day from exporting it all in the form of manufactured articles. On that day the European cotton industry would have ceased to exist. It is indispensable to lose no time if this peril is to be averted. The effort made by Europe will only begin to be felt when a quantity of cotton is put upon the market sufficient to inspire the American producers with respect.

M. Méline considers that at the present time, the main requirement is capital. He strongly urges his countrymen to follow the English example, characterising the liberal support given by Manchester to the British Cotton Growing Association, as evidence of the traditional energy and broad-mindedness of the English man of business. M. Méline anticipates that in a few years the practical and energetic English will have established the cultivation of cotton in their colonies, and will be the first to compete with the American product in the international market. They will thus be the first to secure custom, so that the French will find the place occupied when they are in a position to compete. M. Méline, therefore, regards the question as one of colonial rather than industrial interest, seeing that in a couple of years French manufacturers will have new English or German sources of supply. In conclusion, he expresses the hope that the matter will be taken up by the French Government.

BANANA AND PLAINTAIN.

In connection with the subject of Barbados bananas, referred to on p. 885, vol. lii. of the *Journal*, Nov. 11, 1904, where it was shown that the variety of banana cultivated in the island is the same as that grown in the Canary Islands and Madeira, a question has arisen as to the distinction between the banana and the plantain. Each has been described under distinct scientific names, the banana as *Musa sapientum*, and the plaintain as *Musa paradisiaca*, but botanists have long been agreed that there are but few, if any, distinctive characters by which they can be separated, and that the plantain is simply a variety of the banana, and classifying it as *Musa sapientum* var. *paradisiaca*. At one time, the fruits of the banana were described as being shorter and rounder than those of the plantain, but with the extended cultivation of both, even these characters are not perceptible. The greatest distinction, perhaps, is in the edible qualities of the fruits, the banana being of a more delicate flavour. As a proof of the unity of opinion of the older botanists with those of the present day, it may be said that Roxburgh believed *M. sapientum* to include both the edible fruit known as banana, and the vegetable-like fruit known as plantain, both of which he considered cultivated forms or varieties of the same species.

With regard to the economic side of the question the "Dictionary of the Economic Products of India" further proves the difficulty of fixing a line between the two in the following paragraph: "The fruit of the cultivated forms of this species [*M. sapientum*] are sometimes popularly distinguished by the names of banana and plantain, according to whether they are eaten raw or cooked. These names are, however, very loosely applied, some calling any round and plump fruit 'banana,' others making a distinction in size only, the small being 'banana' the large 'plantain.' It is, therefore, advisable to reject the arbitrary distinction which has arisen between the names, and to call all alike by the commoner name plantain." This may be conveninent in India and other countries, where plantains are generally used as a vegetable, but the name banana, for the edible fruits, has now become so firmly established in England that it cannot well be changed.

LANTERN LECTURES ON THE UNITED KINGDOM FOR USE IN THE COLONIES.

The following memorandum has been issued by the Colonial Office :—

The object of giving to the school children of the United Kingdom better knowledge of the Colonies, and of giving to the school children of each colony better knowledge of the United Kingdom and of other parts of the Empire, has been brought into prominence by various organisations, and commended itself to Mr. Chamberlain when Secretary of State for the Colonies and to Mr. Lyttelton, the present Secretary of State.

With their approval a small Committee has been formed to carry out a suggestion made in the first instance to the Colonial Office by Mr. M. E. Sadler while at the Board of Education, that very first-rate lessons or lectures, to be illustrated by equally good lantern slides should, on the lines which have been successfully followed out in the United States, be drawn up and used in the Schools of the Empire.

The Committee thought that it would be well to begin on a small scale and in a very modest way, but bearing constantly in mind that if the experiment is to succeed, the letterpress and the illustrations must be the best possible.

Accordingly, acting under the Secretary of State's authority, they drew up a syllabus of seven lectures on the United Kingdom,* each to be illustrated by some forty lantern slides, the subject of the lectures being

(1) The journey from the East to London.
(2) London the Imperial City.
(3) Scenery of the United Kingdom.
(4) Historic centres and their influence on national life.
(5) Country life and the smaller towns.
(6) Great towns, the Industries, and Commerce.
(7) Defences of the Empire.

This syllabus, designed for use primarily in the Eastern Colonies, was sent out to the Governments of the three colonies of Ceylon, the Straits Settlements, and Hongkong, and each colony was asked and consented to give a grant of £300 to cover the expenses of the scheme.

The money being available, Mr. Lyttelton consented to the Committee's request that Mr. H. J. Mackinder, Director of the London School of Economics and Political Science, should be asked to undertake the preparation of the lectures and the general superintendence of the scheme.

Mr. Mackinder accepted the invitation and the lectures will be, in the first instance, delivered in a London Training College for Elementary Teachers. They will be reported verbatim, put into print, and be corrected and edited by the lecturer, the whole, with any special slides which may be designed for the purpose, becoming the property of the three Colonies concerned, but being available for sale to other Colonial Governments.

* Miscellaneous No. 157.

It will be borne in mind that

(1) The lectures are intended for the higher classes in Elementary Schools, or with modifications for adults.
(2) Each lecture may well supply several hours' lessons, being intended to be the text for teaching and a guide as to the method of teaching, and not simply to be repeated word for word in a single hour.
(3) The object is to give to children through their eyes as well as their ears a true and simple impression of what the United Kingdom and its people are like, to explain to children living in the tropics what the seasons mean in this country, and so forth.
(4) The lessons may well be translated into the vernacular languages for use by native teachers.

The Eastern Colonies will also supply material for similar lectures upon them to be used in this country.

Mr. Mackinder has been asked, and has consented to give in December next a lecture, at a place and time to be fixed,* in which he will give an account of the scheme, and at which some of the slides which have been prepared to illustrate it will be exhibited; it is hoped that those who are interested in promoting mutual knowledge of the various parts of the Empire will be present.

TESTS OF NATIONAL PROGRESS.†

In a paper read at Southport, Mr. A. L. Bowley suggested tests by which the national progress in economic well-being might be measured over any defined period. The necessary statistics covering the forty years from 1860 are now offered. The test measurements are of wages, employment, income, prices, and consumption. An index number is formed for average wages, allowing for irregularity of work. A new estimate is made for income, subject to income-tax, allowing for all the changes in methods of assessment, and including estimates for income unduly escaping tax; and a special method is employed for dealing with the changes in the exemption limit. An index number is then formed for average income. The two series of index numbers, for wages and income, are found to have very many points of resemblance; both show a rapid rise from 1860 to 1874, a fall to 1878, two fluctuations to 1893, and a rapid rise to 1900. The series are then combined, and allowance is made for the fluctuations of prices; the resulting index number shows a nearly regular progress throughout the forty years. The index number for consumption of common necessaries also shows fairly regular pro-

* It has now been arranged that the lecture shall be given at the Whitehall Rooms, Hotel Metropole, on Wednesday, 7th December, at 5.0 p.m. The Secretary of State has consented to preside.

† Abstract of paper read by A. L. Bowley, M.A., before Section F of the British Association meeting at Cambridge.

gress. It is contended that the series used are consistent with and support each other, and that there has been steady progress decade by decade, though perhaps less rapid and continuous than the final series suggests. Other tests are considered, and rejected because of their incompleteness.

GENERAL NOTES.

HYDRAULIC MINING CARTRIDGE.—The General Report of Mines and Quarries for 1903 (Part 2, Labour) contains the following reference to the success of the Hydraulic Mining Cartridge, for which Mr. James Tonge, jun., was awarded the Shaw prize by the Council of the Society of Arts in 1902 — "Though coal-cutting machines will probably reduce the number of accidents from falls of roofs and sides owing to the fact that machine-cut faces are necessarily timbered systematically, they have introduced some fresh dangers. The most disquieting of these dangers is the increase of shot-firing which frequently follows the introduction of coal-cutters. The hope has long been cherished that some method of breaking down the coal and rock would be devised to supersede shot-firing. Lime-cartridges and patent wedges have been extensively tried from time to time, but have never been very successful. An hydraulic cartridge or wedge has now, in at least one colliery, proved a practical success and entirely superseded the explosives formerly used. Mr. Gerrard (District No. 6) gives interesting particulars of this contrivance. No less than 214,800 tons of coal were brought down with it and larger coal was obtained than by blasting. It was recently awarded the Gold Medal of the Society of Arts under the terms of the Benjamin Stone [Shaw] Bequest,— "For any discovery, invention, or newly devised method of obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

NOVEMBER 30.—"The British Canal Problem." By ARTHUR LEE, J.P. The RIGHT HON. SIR MICHAEL HICKS BEACH, Bart., D.C.L., M.P., will preside.

DECEMBER 7.—"The International Exhibition at St. Louis." By WALTER FRANCIS REID, F.I.C., F.C.S. DR. BOVERTON REDWOOD, F.R.S.E., will preside.

DECEMBER 14.—"The Patent Laws." By CHAS. D. ABEL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

DECEMBER 8.—"Burma." By SIR FREDERIC FRYER, K.C.S.I. The RIGHT HON. the EARL of HARDWICKE, Under-Secretary of State for India, will preside.

January 19, February 16, March 16, April, 6 May 11.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock :—

January 24, February 28, March 28, May 23.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

DECEMBER 20 (8 p.m.).—"Street Architecture." By THOMAS GRAHAM JACKSON, R.A. DR. G. B. LONGSTAFF will preside.

January 31, February 21, March 21, April 11, May 16.

Papers for Meetings after Christmas :—

"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By The RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY.

"London Electric Railways." By the HON. ROBERT P. PORTER.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTAN.

"The True Musical Pitch of Notes we See and Sounds we Hear." By JOHN E. BORLAND.

"Popular Jewelry." By MONSIEUR LALIQUE (Paris). (*Applied Art Section.*)

"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. (*Colonial Section.*)

CANTOR LECTURES.

The following courses of Cantor Lectures will be delivered on Monday evenings, at 8 o'clock :—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with musical illustrations).

LECTURE I.—NOVEMBER 28.—Introduction—Music and the practical arts—Division of instruments into string, wind, and percussion—Limitation of definition—Wind instruments and the human voice—Acoustics and the art of instrument making—Vibration and wave motion—Every wind instrument a vibrating column of air—Stationary waves—Means of exciting vibration—Wave-form—Classification into brass, reed, and flute.

LECTURE II.—DECEMBER 5.—*Brass Instruments.*—Primitive instruments from horns and shells—Harmonic scale—Development into bugle and trumpet types—natural horns and trumpets—Introduction of slides, keys, and valves.

LECTURE III.—DECEMBER 12.—*Reed Instruments.*—Single and double reeds—Conical and cylindrical tubes—Bagpipes—Shawms, oboes, and bassoons—Clarionets—Saxophones.

LECTURE IV.—DECEMBER 19.—*Flutes.*—Modern limitation of the name—Action of the air-reed—Recorders and flageolets—Cone and cylinder flutes.

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Fountain, and Stylographic Pens." Three Lectures.

January 23, 30, February 6.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HENRY LAWS WEBB, "Telephony." Four Lectures.

March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

JUVENILE LECTURES.

Two lectures suitable for a juvenile audience will be delivered on Wednesday evenings, January 4 and 11, 1905, at Five o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. David James Blaikley, "Musical Wind Instruments." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. C. John Mann, "The Building Surveyor: his Training and Practice."

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C, 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Henry A. Miers, "The Diamond Mines of Kimberley."

TUESDAY, Nov. 29...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by Mr. John Francis Cleverton Snell, "Distribution of Electrical Energy."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Capt. Richard Crawshay, "Some Observations on the Field Natural History of the Lion," 2. Sir Charles Eliot, "Some Nudibranchs from East Africa and Zanzibar" (Part VI.). 3. Mr. R. Lydekker, "The Altai Lynx." 4. "Old Pictures of Giraffes and Zebras." 5. Dr. H. J. Hansen, "The Morphology and Classification of the *Asellota* group of Crustaceans, with descriptions of the genus *Stenetrium* and its species." 6. Mr. G. A. Boulenger, "The *Lacerta depressa* of Camerano."

Horticultural, Vincent-square, S.W., 3 p.m.

WEDNESDAY, Nov. 30..SOCIETY OF ARTS, John-street, Adelphi, W.C. Mr. Arthur Lee, "The British Canals Problem."

Royal, Burlington-house, Piccadilly, W., 4 p.m. Annual Meeting.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, DEC. 1...Linnean, Burlington-house, W., 8 p.m. Prof. Sidney H. Vines, "Proteid digestion in Animals and Plants."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8 p.m. Mr. P. C Ray, "The Nitrites of the Alkali Metals and Metals of the Alkaline Earths."

London Institution, Finsbury-circus, E.C., 6 p.m. Col. Sir Thomas Holdich, "Tibet."

Tramways and Light Railways Association (in the ROOMS OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. Stephen Sellon, "Running Powers."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, DEC. 2...Aeronautical (at the HOUSE of the SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. 1. Major B. Baden-Powell (President), "The Aeronautical Exhibits at St. Louis Exhibition." 2. Mr. W. W. Dines. "Kites, Kite Flying, and Aëroplanes." 3. Dr. M. H. Hagesell, "The Work of the Aeronautical Commission." 4. Mr. Griffiths Brenow, "Captive Balloon Photography."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. R. T. McCallum, "Midland Railway, West Riding Lines: the Construction of Contract No. 1."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Geologists' Association, University College, W.C., Mr. A. E. Salter, D.Sc., F.G.S., "The Superficial Deposits of Central and parts of Southern England."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Journal of the Society of Arts.

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FRIDAY, DECEMBER 2, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 5, 8 p.m. (Cantor Lecture.) D. J. BLAIKLEY, "Musical Wind Instruments." (Lecture II. Brass instruments.)

WEDNESDAY, DECEMBER 7, 8 p.m. (Ordinary Meeting.) WALTER FRANCIS REID, "The International Exhibition at St. Louis, U.S.A."

THURSDAY, DECEMBER 8, 4.30 p.m. (Indian Section.) SIR FREDERIC FRYER, K.C.S.I., "Burma."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 28th ult., Mr. D. J. BLAIKLEY delivered the first lecture of his course on "Musical Wind Instruments."

The lectures will be printed in the *Journal* during the Christmas recess.

CANTOR LECTURES ON MAJOLICA.

Prof. R. Langton Douglas's Cantor lectures on the "Majolica and Glazed Earthenware of Tuscany," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, November 30, 1904; The RIGHT HON. SIR MICHAEL HICKS BEACH, BART., D.C.L., M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Chambers, John, Mokopeka, Hastings, Hawke Bay, New Zealand.
Hippisley, Clare Robert, 4, Belgrave-terrace, Bath.
Moorcroft, William, Marsh-avenue, Wolstanton, Staffs.
Owen-Jones, John, Shortmead-street, Biggleswade, Beds.
Peacock, James, 13, Fenchurch-avenue, E.C.
Sapara-Williams, Hon. C., M.L.C., Lagos, West Africa.
Smith, Thomas Strethill, 32, West-hill-road, Southfields, S.W.
Watkins, John, 48, Westbourne-street, Sloane-square, S.W.
Weston, Edward, 645, High-street, Newark, New Jersey, U.S.A.

The following candidates were balloted for and duly elected members of the Society:—

Aiyangar, S. Krishnasvami, M.A., Central College, Chamarajendrapet, Bangalore City, India.
Aldridge, Walter H., Canadian Pacific Railway Company, Canadian Smelting Works, Trail, British Columbia.
Alexander, W. W., The Town Clerk, Heidelberg, Transvaal, South Africa. (P.O. Box 201.)
Anderson, Robert Bruce, Assoc.M.Inst.C.E., 5, Westminster-chambers, S.W.
Attridge, Ernest William, Simons Town, Cape Colony, South Africa.
Austin, Henry B., J.P., Government Offices, Bloemfontein, Orange River Colony, South Africa.
Ayton, Ernest F., M.Am.I.M.E., Apartado Postal 141, Parral, Estado de Chihuahua, Mexico.
Ballantyne, William Smith, Mortgage-buildings, Pretoria, Transvaal, South Africa.
Balta, José, Ministerio de Fomento, Lima, Peru, South America.

Barnes, F. J., Portland Stone Quarries, Isle of Portland, Dorset.
Barton, Geoffrey Berkley, Guntakal, Southern Mahratta Railway, Madras, India.
Bellamy, Franklin J., Yeovil.
Bird, Frank Noel, A,M.I.Mech.E., Wellington Mills, Dardanup, Western Australia.
Black, Francis, R.B.A., Crofton, Mountfield-road, Church-end, Finchley, N.
Bodkin, Archibald Henry, 5, Paper-buildings, Temple, E.C.
Boot, W. H. J., R.B.A., Markeaton, Well-road, Hampstead, N.W.
Bourke, E. F., The Bourke Trust and Estate Company, P.O. Box 321, Pretoria, Transvaal, South Africa.
Brassey, The Hon. Thomas Allnutt, 4, Great George-street, S.W., and Park-gate, Battle, Sussex.
Buller-Allan, Edward, M.D., Maldon, Victoria, Australia.
Burns, Thomas, 25, Diana-street, Newcastle-on-Tyne.
Burton, Joseph James, Rosecroft, Nunthorpe R.S.O., Yorks.
Butler, Edwin T., 26, Craven-park, Willesden, N.W.
Carr-Calthrop, Colonel C. W., M.D., 51, Pembridge-villas, Notting-hill-gate, W.
Chand, Rai Bahadur Lal, M.A., Chief Court, Lahore, India.
Chilvers, George William, 59, Stile Hall-gardens, Chiswick, W.
Church, Harry, 138, Crystal Palace-road, East Dulwich, S.E.
Clark, Augustus, M.I.Mech.E., Recife, Pernambuco, Brazil, South America.
Clark, George Stirling, 35, Upper Belgrave-road, Clifton, Bristol.
Clayton, Charles E., A.I.E.E., City of London Asylum, near Dartford, Kent.
Cobbe, Hervic Nugent Grahame, F.G.S., care of Kalgurli Gold Mines, Ltd., Kalgoorlie, Western Australia.
Cock, Edward A. Langslow, Seremban, Federated Malay States.
Colston, Miss Lilian, 34, Curzon-street, Mayfair, W.
Cottingham, Captain Henry Langrishe, R.A., 70, Carlton-mansions, Maida Vale, W.
Dale, Thomas Henry, M.R.C.V.S., Government Experimental Farm, Potchefstroom, Transvaal, South Africa.
Däll, Alexander Percival, N.G.S.Ry., Secunderabad, Deccan, India.
Darby, Arthur Ernest, A.M.I.Mech.E., Town Hall, Wolverhampton.
Dickens-Lewis, George Edwards, Talbot-chambers, Shrewsbury.
Docker, Edward, Etaples, Pas de Calais, France.
Dollar, John A. W., M.R.C.V.S., F.R.S.E. (President of the Royal College of Veterinary Surgeons), 56, New Bond-street, W.
Dove, Frederick L., 15, Studd-street, Islington, N.
Ebstein, Mrs. Bertha, Leighton-house, Adrian-road, Stamford-hill, Durban, Natal, South Africa.
Edge, S. F., 3, Whitehall-court, S.W.
Edmonds, Captain Richard James, M.I.Mech.E., H.M. Gun Wharf, Portsmouth.
Ekberg, Miss Annie Elizabeth, Doveton-street, Ballarat, Victoria, Australia.
Enraght-Moony, Francis, Resident Commissioner, Mbabane, Swaziland, South Africa.
Fennell, John Howard, Rio Tinto, Spain.
Fleming, Robert, 2, Princes-street, E.C.
Forrest, George Topham, County Architects' Department, County Hall, Wakefield.
Fox, Alfred, jun., Assoc.M.Inst.C.E., care of Señor J. E. Harmsen, Arequipa, Peru, South America.
Frodsham, Harold, A.I.E.E., "E.C." Powder Works, Bean, *viâ* Dartford, Kent.
Fullwood, John, R.B.A., Studio, Slinfold, Horsham, Sussex.
Furnivall, F., East India United Service Club, 16, St. James's-square, S.W.
Galbraith, David Rankin Shirreff, F.I.C., Galbraith Iron and Steel Co., Ltd., P.O. Box 371, Auckland, New Zealand.
Gardner, Richard Core, 173, Fleet street, E.C.
German, Bernard Foster, care of Messrs. Grindlay and Co., Calcutta, India.
Gibbings, Major Henry Cornwall Cotton, Junior Naval and Military Club, 96, Piccadilly, W.
Gledhill, Gideon, Northfield, Edgerton, Huddersfield.
Gordon, Vivian, The Vache Park, Chalfont St. Giles, Bucks.
Granger, John Maxwell, care of Mrs. J. Mackenzie, Buller-street, Cambridge, East London, South Africa.
Grayson, George E., F.R.I.B.A., Greenbank, Egerton-park, Rock Ferry, Cheshire.
Greenwood, William, M.Inst.C.E., Cape Government Railways, Prieska, Cape Colony, South Africa.
Greg, Lionel Hyde, Dowlaishweram, Godavari District, Madras, India.
Grieve, James Henry, Assoc.M.Inst.C.E., El Damer, Sudan, Egypt.
Groves, Thomas, A.M.I.Mech E., Taiping, Perak, Federated Malay States.
Gurtoo, R., Chandni Chauk, Cuttack, Orissa, Bengal, India.
Hamilton, Charles Joseph, B.A., F.S.S., University College, Cardiff.
Harper, James, Assoc.M.Inst.C.E., Ferro-Carril Nord Este Argentino, Monte Caseros, Argentine Republic.
Hawthorn, John Henry, M.A., Municipal Technical School, The Newarke, Leicester.

Heron, J. S., Pennant-hills, New South Wales, Australia.

Higgs, Frederick, Station Works, Loughborough Junction, S.E.

Hollis, Sydney Ainslie, A.M.I.Mech.E., Town Hall, Bloemfontein, Orange River Colony, South Africa.

Hope-Edwards, Lieut.-Col. Herbert J., Netley Hall, Shrewsbury.

Houghton, Bernard, Moulmein, Burma.

Hutton, Richard B., Aldersbrook-house, Forest-drive, Manor-park, Essex.

Irani, Rustomji Hormusji, Thull-Parachinar Railway Survey, Thull, India.

Jackson, David Hamilton, Ph.D., M.A., 47, Mecklenburg-square, W.C.

Jeff, William, Northfleet District Engineering Works, Northfleet, Kent.

Jeffries, Joseph, A.M.I.E.E., 29, Court-road, Balsall-heath, Birmingham.

Jones, Bernard Gustave, A.I.E.E., 33, Commercial-street, Newport, Mon.

Jones, Cyrus, 282, Western Bank, Sheffield.

Khan, Khan Bahadur Sarfaraz Hosein, Patna City, Bengal, India.

Kisch, Stanley A., F.R.G.S., 31, Fox-road, West Bridgford, Notts.

Lagerwall, Richard Emil Magnus, Marylands, Gravesend, Kent, 157, Southwark-bridge-road, and 87, Sumner-street, S.E.

Landon, Will de Manoel, Wychwood, Poplar-grove, Sale.

Larkman, Alfred E., 78, High-street, Southampton.

Latimer, John, M.Inst.C.E.I., 12, Denny-street, Tralee, Ireland.

Leeson, Joseph George, 39, Tyrwhitt-road, St. John's, S.E.

Leigh, Arthur Graham, F.C.S., Chorcliffe-house, Chorley, Lancs.

le Sueur, Gordon, Kenilworth, Cape of Good Hope, and 29, Albemarle-street, W.

Linzell, Alexander Daniel, 49, Heathwood-gardens, Charlton, S.E.

Lockhart, Philip Henry, 22, Harley-house, Regent's-park, N.W.

Lord, F. A. B., A.I.E.E., Messrs. W. F. Dennis and Co., 49, Queen Victoria-street, E.C.

Lowcock, Charles Frederick, R.B.A., Roxborough, Clarendon-road, South Woodford, Essex.

McCallum, Edward Alfred, A.M.I.Mech.E., Russian Petroleum Co., Ltd., Baku, Russia.

McEwen, Samuel, A.R.S.M., 1, Lansdown-place, Brunswick-square, W.C.

Macey, Frank, High-street, South Ockendon, Essex.

McGregor, James, A.M.I.Mech.E., Fair-view, Melrose, N.B., and Natal Government Railway Locomotive Works, Durban, Natal, South Africa.

McIntyre, Miss J. A., West New Brighton, New York, U.S.A.

Maitra, Bhuban Mohun, K.I.H., Ghoramara P.O., Rajshahi, Bengal, India.

Manuel, Constantine, 116, Chancery-lane, W.C.

Mastin, John, R.B.A., 37 to 39, Foster's-buildings, High-street, Sheffield.

Maurice, R. T., 5, Macclesfield-street, Shaftesbury-avenue, W.

Mercer, Frank, 14, Prospect-road, St. Albans.

Mitra, S. M., M.R.A.S., Hyderabad, Deccan, India.

Moorhouse, Edwin, A.M.I.E.E., 2, Belmont-grove, Clarendon-road, Leeds.

Morgan, K. P. Vaughan, The Morgan Crucible Company, Ltd., Battersea Works, S.W.

Nathan, Henry, 11, Hanover-terrace, Regent's-park, N.W.

Nesbitt, Alexander Walter, M.I.Mech.E., 40, Dartmouth-row, Blackheath-hill, S.E.

Nichols, Henry John, A.M.I.Mech.E., 15, Fair-lawn-avenue, Chiswick, W.

Parasnis, D. B., Happy-vale, Sataro, Bombay, India.

Patel, Khan Bahadur Burjorjee Dorabjee, C.I.E., Quetta, Baluchistan, India.

Peattie, John, 18, Dorset-street, Baker-street, W.

Phillimore, Hugh Bouchier, Assoc.M.Inst.C.E., Kuala Lumpur, Federated Malay States.

Porteous, William, 14, Buckingham-street, Adelphi, W.C.

Pott, Francis Holliday, Messrs. Burt and Potts, 38, York-street, Westminster, S.W.

Pover, George Alfred Franklin, A.M.I.Mech.E., Cavendish-villa, 53, Hencroft-street, Slough, Bucks.

Reid, Edwin S., The National Conduit and Cable Co., Ltd., 1, Oxford-court, Cannon-street, E.C.

Reilly, John, F.S.S., 17, Nassau-street, Dublin.

Reyersbach, Louis, P.O. Box 149, Johannesburg, Transvaal, South Africa.

Robinson, John H., Lanthwaite, 42, Dartmouth-row, Blackheath, S.E.

Ronan, Barry, Somerville Hotel, Church-street, Maritzburg, Natal, South Africa.

Samson, John, 42, Parkhill-road, Hampstead, N.W.

Savage, G. H., Sunnyside, Cape Coast Castle, Gold Coast, West Africa.

Sawhney, Bhagat Ram, M.B., M.R.C.S., Chief Medical Officer, Jammu Province, Jammu, Kashmir State, India.

Semark, Charles Henry, Amroth, London-road, Faversham.

Sharpe, Charles James, 130, Fenchurch-street, E.C.

Shepheard, Herbert B., A.I.E.E., Falkirk, Grange-road, Ealing, W.

Sherry, Richard H., Westlake, Grahamstown, Cape Colony, South Africa.

Shirley, Arthur, 122, Castlenau, Barnes, S.W.

Shorter, John, 193, Clarence-street (P.O. Box 469), Sydney, New South Wales, Australia.

Singh, Professor Kishan, B.A., 21, Golden Temple, Amritsar, India.

Slinn, Edward John, J.P., 19, Park-road, Watford, Herts.

Smith, Harry, Natal Harbour Department, Durban (P.O. Box 28, Point), Natal, South Africa.

Smith, Miss Gertrude, 3, Wilton-road, Merton-park, Wimbledon, S.W.
Smock, John C., Trenton, New Jersey, U.S.A.
Sopwith, John, A.M.I.Mech.E., Bridge-house, Blackwall, E.
Spangler, Prof. Henry Wilson, Department of Mechanical Engineering, University of Pennsylvania, Philadelphia, U.S.A.
Spencer, Charles F., York-chambers, Halifax.
Spenlove-Spenlove, Frank, R.B.A., The Corner House, 69, Addison-road, W.
Sperring, A. E. O., "The Cigar and Tobacco World," 150, Holborn, E.C.
Spielmann, Isidore, 56, Westbourne-terrace, Hyde-park, W.
Sproule, George Huston Russell, A.M.I.Mech.E., Locomotive Depôt, C.S.A. Railways, Braamfontein, Johannesburg, South Africa.
Steers, William E., care of National Bank of South Africa, London-wall, E.C.
Stovin, Cornelius Frederick, M A., Medical Officer of Health, Council Offices, Ilford, Essex.
Swinney, Herbert, 27, Bridge-street, Chepstow.
Taylor, Frederic Henry, 14, Victoria-street, S.W.
Thomas, R. H., The Transvaal Tin Mines, Oshoek, *viâ* Carolina, Transvaal, South Africa.
Thompson, James, 14, Preston-road, Westcliff-on-Sea.
Thomson, Edward John, Western Club, Glasgow.
Tolhurst, John. Glenbrook, Beckenham, Kent.
Tyler, Harold William, Entebbe, Uganda, *viâ* Mombasa, British East Africa.
Van Raalte, Emanuel, 2, Glasshouse-street, Regent-street, W.
Varley, Jesse, Longleat, Paget-road, Wolverhampton.
Verde, Comandante Felice, Via Fazio 7, Spezia, Italy.
Victory, Louis H., "The Leinster Leader," Ltd., Naas, Ireland.
Wainwright, Joseph, 15, Bolton-road, Port Sunlight.
Wallis, H., District Engineer, Cape Government Railways, De Aar, Cape Colony, South Africa.
Warner, Thomas W., Messrs. Kinton, Warner and Co., 25A, Ægis-buildings (P.O. Box 1,147), Johannesburg, Transvaal. South Africa.
Watkin, Henry, Watcombe-house, Waterloo-road, Burslem.
Watson, Hugh Munro, Kildonan, 22, Coleraine-road, Blackheath, S.E.
Wetzler, Joseph, M.I.E.E., 203-208, Temple-chambers, Temple avenue, E.C.
Whitwell - Allen, George, 35A, Geraldine - road, Wandsworth-common, S.W.
Williamson, H., A.M.I.Mech.E., Messrs. Samuel Samuel and Co. (P.O. Box 273), Yokohama, Japan.
Winter, Frank, A.C.A., 12, Sanderson-road, Newcastle-on-Tyne.
Woods, Harry, A.M.I.Mech.E., Kalline Tea Estate, Kalain, P.O., Cachar, India.

The paper read was—

THE BRITISH CANALS PROBLEM.

By Arthur Lee, J.P.

When a great system of railways was first established in this country it seems to have been hastily assumed that canals would be no longer necessary, and that their decay and ruin might be regarded with equanimity. The railway companies were allowed to obtain control of 1,138 miles of canal, out of a total of 3,906, and these, to use the words of a witness before the Select Committee of 1883, were "so adroitly selected as to strangle the whole of the inland water traffic."

During the past twenty years, largely owing to the action taken by the Society of Arts, the Mansion House Association, and the Associated Chambers of Commerce, public interest in our inland waterways has been revived, but although a vast amount of information upon the subject has been obtained, very little has been done to turn it to practical account. With the single great exception of the Manchester Ship Canal, no improvement of any consequence has been made in the system of inland waterways which was in existence in this country before 1825. Not only is this the case, but long lines of water communications once open have been allowed to fall into ruin and decay, and in this respect we are worse off than we were during the early part of the last century.

It may be that those are right who assume that we may view the decay and ultimate destruction of our inland waterways with equanimity, that in the railways we have all that is necessary as a means of transport, and that the sooner we close up our canals, and turn the land they occupy to other purposes the better for the community. But before we adopt such a policy, it is well to remember that Great Britain alone of all the great trading nations in the civilised world pursues a policy of deliberate neglect of her inland waterways.

At the instance of the Bristol Chamber of Commerce, the Associated Chambers recently obtained from the Foreign Office a series of reports upon

The Policy Adopted by our Continental Competitors

with regard to inland water communication. The British Consuls in France, Holland, Belgium, Germany, and Austria, were instructed to report specially upon the following points:—

(1) As to the capital expended during the

past twenty-five years in developing the waterways, and the methods by which they have been improved.

(2) As to the tolls chargeable upon traffic, and the manner in which interest on capital expended is provided for.

(3) As to the results which have followed improved means of transport by water (*a*) with regard to the railways, (*b*) with regard to the seaports, (*c*) with regard to the trade and commerce of the country.

These reports deserve the earnest study and consideration of the trading community.

France.—Torn and impoverished by the war with Germany, the French nation set itsel resolutely to work immediately peace was declared to improve its industrial condition. One of the first great measures undertaken with this end in view was the appointment of a Commission to enquire into railways and other means of communication. The Commission found that the canal system of France had been neglected, and they recommended that immediate steps should be taken to improve it. "If there be devoted to it," they said, "but a small fraction of the efforts which for twenty years have been concentrated exclusively on railways, great results will follow." "The disjointed manner and want of foresight with which a great part of the barge service is carried on must be altered. It must cease to consider itself a moribund industry, and must apply itself to commercial exigencies."

The enterprise of the French people promptly followed this recommendation by vigorous action. Between 1872 and 1878 France spent £9 640,000 on the improvement of her waterways and maritime ports. In 1879 a new and comprehensive scheme was drawn up. In the execution of this programme £18,000,000 was spent between 1879 and 1900. The total length of first-class waterways was increased from 906 miles to 2,930 miles of newly constructed canals.

The French waterways at present in the hands of public bodies other than the State form only an insignificant fraction of the whole; practically the whole of the waterway system is the property of the State which maintains it out of the funds free of all tolls.

The justification of a system of toll-free canals is to be found in the Report of the Government Commission of 1872:—

"If," says that Report, "the canal promotes agricultural improvements, stimulates the establishment of factories, facilitates the working of mines, quarries, and forests: increases in a word the public wealth, the State, its inevitable partner, takes its share of all such increased wealth, and that share is perhaps sufficiently large to do away with the necessity of levying any direct toll. It is thus that the State and Departments have been enabled to construct and maintain roads without demanding any toll from the public who use them. It is this fact alone which, though in a less degree, admits of the existence of these canals from which the State realises a moiety of the expenses of maintenance. But under such apparently erroneous liberal views lies a true perception of the wants of the country, which induces the State before everything to augment its wealth and production, and also a profound equity of taxation for the impost laid upon wealth created by help of the canals diminishes the burdens of the whole community, even of that portion of it which does not make use of them."

The result of an expenditure in France of over £27,000,000 on navigable waterways has been attended by a great development of the water traffic, and it is noteworthy that during the same period the railway traffic has also largely increased, though far less rapidly in proportion. M. Picard, then President of Public Works, at a meeting of the State Council, spoke of the canal built to connect the Marne with the Rhine, as having given a wonderful impetus to the mineral and other industries of Lorraine—industries which could not have been born, according to him, except for cheap transit facilities. "Minerals," he said, "which lay undisturbed before its construction are now being actively extracted; factories and furnaces are so numerous upon its banks and press so closely upon each other that one might imagine them sprung up from the earth." In fact "83 per cent. of the industries upon its banks have been established since the canal was cut."

By a law passed Jan. 30th, 1902, a new credit, amounting to over £28,000,000, was voted to extend the system of French waterways.

This amount is allocated as follows:—

Improvement of existing waterways	£2,425,200
New waterways	19,195,000
Improvement of waterways	6,523,000
	£28,133,200

This expenditure is to be recouped by tolls to be levied as follows:—

On boats, 1-15th of a penny per ton per mile.
On goods, Class 1, 3-5ths ditto.
On goods, Classes, 2-4, 3-20ths ditto.

Germany.—Mr. Gastrell, the Commercial Attaché to the British Embassy in Berlin,

reports that during the earlier period of the development of the railways up to 1875 there existed in Germany, as in most other countries, a feeling that inland transport by water was doomed to languish, it being thought impossible that it should ever be able to compete with the extensive railway systems. Even the best-informed persons in the early days of the German Empire after 1871 only believed in a survival of canal transport as competing in certain districts with the high roads. Since 1875, however, public opinion gradually looked more favourably on the possibilities of a development of the inland waterways.

The expenditure on the waterways in Germany in the ten years 1890-1899 was £14,950,320, and it has been found, with the continued improvement and extension of the waterways and harbour accommodation, that inland shipping has considerably increased. The general practice as regards the levying of dues is to leave the navigation on the open river free, while imposing charges in many cases for the use of harbours and wharfs; on all canals regular charges are made for the navigation. Public opinion in Germany differs as to the extent to which dues can be properly collected. One view is that interest on the capital invested on waterways should be provided entirely out of the navigation dues, while another view is that all expenditure (except for the cost of furnishing special facilities) should be paid by the State in order to provide absolutely free waterways on the same footing as high roads. In 1900 the actual length of the waterways within the German Empire was, according to Imperial statistics, 8,798 miles.

A further expenditure of £22,000,000 is contemplated to be made to extend the German canal system. This will provide a network of satisfactory waterways through the whole of North Germany, an improved waterway between Berlin and Stettin, the construction of the Dortmund Rhine canal, and of a canal from Bevergen on the Dortmund Ems canal to Hanover.

Austria-Hungary possesses internal navigable waterways of the approximate length of 4,000 miles, on which between 1848 and 1898 £21,000,000 were expended. Mr. Bennett, the Commercial Attaché to the British Embassy at Vienna, reports that owing to the rapid development of the railway system at the beginning of the latter half of the nineteenth century, river traffic in Austria-Hungary as elsewhere lost for some time the importance which it had previously possessed, and it almost seemed that on some rivers it would come to a complete standstill. To this circumstance may be ascribed the fact that it is only of comparatively recent date that earnest attention on the part of the State has been given to river regulation, for it has become evident in the face of the ever increasing traffic, that the railways are not in a position to grant those cheap rates which economic interests demand, more especially for the carriage of bulky merchandise of small value.

By the law of June 11, 1901, over £10,000,000 were voted for the construction of a network of navigable canals in Austria and for the necessary river regulation in connection therewith. The first period of construction is reckoned from 1904 to 1912, at the expiration of which a new credit will be demanded for the completion of the scheme.

The internal navigable waterways of Hungary possess a total approximate length of 3,082 miles. In 13 years the river traffic of the country has increased from 2,520,000 tons to 3,640,000 tons. With the projected new navigable canals on a large and comprehensive scale the question of inland navigation is entering upon a new and important phase, and is at the present time largely absorbing public attention in the Dual Monarchy.

Belgium.—In Belgium the capital expended by the State during the period extending from 1875 to 1900 on the improvement of navigable waterways and harbours is estimated at £16,000,000. The State administers the greater portion of the system, but certain portions of the inland waterways are administered by the provinces, some by communes and municipalities, and a small proportion has been conceded to companies, associations of landowners, and individuals.

As a general rule the tidal rivers are exempt from tolls. Upon the canals tolls are levied at so much per ton of freight for each kilometre. These tolls are based on an exceedingly low scale, the rate fixed being under 1-6th of a penny per ton per kilometre on rivers which have been rendered navigable by means of locks, and 1-20th of a penny on canals. The traffic on the navigable waterways has grown enormously, from 250,000,000 mile tons in 1880 to 560,000,000 mile tons in 1900, an increase of 124 per cent., while at the same time the tonnage of freight transported by railways has trebled.

Finally it is reported that although it is impossible to estimate even approximately the

extent to which the improvement of the waterways has contributed to the great development of traffic, yet it may be justly claimed that in providing the country with a system of navigable waterways and cheap transport, in multiplying the points of contact between road, rail, and water transport, and thus facilitating transhipments, in rendering the seaports easier of access and in stimulating the erection of numerous commercial and manufacturing establisments, this work of improvement has been one of the principal factors of the commercial prosperity of the country.

Holland.—Long before the construction of railways the waterways of Holland were the traffic carriers of both goods and passengers throughout the land at rates so low that competition on the part of any other known means of transport was, and remains, a practical impossibility so far as local goods traffic is concerned. As late as forty years ago there were only three existing lines of railway of any importance in Holland, and these had a hard struggle for existence. About the year 1860 the urgent necessity for railways was forced upon the Government, but it was impossible to induce private capital to undertake a competition with the abundant and excellent waterways with which the nation was provided. The construction of a considerable network of railways was therefore undertaken by the State and with excellent judgment, for the railways have proved the salvation of many districts which seemed doomed to decay. The State railways were constructed at the cost of the nation, and after considerable discussion as to the means of working them to the best advantage they were handed over to a private company expressly promoted for the purpose, the State providing the permanent way and the buildings, while the company provided the rolling stock and *personnel* and worked the new lines to the best advantage. The surplus of receipts over expenditure exclusive of that on capital account is divided in certain proportions between the State and the company. The latter has paid fair, but not large, dividends to the shareholders, while the amount received by the State has never sufficed to pay more than one per cent. per annum on the capital which it has expended.

Notwithstanding the fact that it was necessary to establish a system of State aided railways to supplement the existing excellent inland waterways, Holland has spent large capital sums in the improvement and extension of the waterways themselves. Between 1862 and 1901 nearly £17,000,000 sterling was thus expended, the most important work being the Merwede Canal connecting the port of Amsterdam with the Rhine. Mr. W. C. Robinson, the British Consul at Amsterdam, reports that the building of this canal has had a very favourable influence upon the prosperity of the port. The total tonnage of Rhine and other traffic using the canal has increased from 1,420,257 tons in 1892 to 4,433,257 tons in 1899. This great increase of tonnage was not carried out at the expense of the competing railways, as on the contrary, the quantities of goods reaching and leaving Antwerp by railway show also a marked increase.

The net result of a careful study of the continental traffic systems proves that

The Experience of Continental Nations has been that both canals and railways are necessities, and that increase of traffic on the one means increase of traffic on the other. France and Germany, after the advent of railways, seem to have neglected their canals for a time, but speedily awoke to the conclusion that this was a mistaken policy, and, during recent years, have expended many millions of capital to bring their ancient waterways abreast of modern conditions. Holland, which was so admirably served in the matter of waterways that private capital could not be found to build railways to compete with them, discovered that to rely upon canals alone would mean the impoverishment of whole districts, and that railways must be built, and equipped, even to the extent of providing them in great measure at the cost of the State.

In Great Britain

we are still discussing the question of what shall be done with our canals, and have not yet arrived at any practical conclusion. I readily admit that the conditions under which trade is carried on in this country may make a continental analogy misleading, but is it the case that the conditions are so different that we can afford to altogether disregard the experience of our neighbours and competitors? It is argued that despatch is of paramount importance in this country, and that a large amount of traffic is forwarded in small consignments. It is true that in the matter of despatch and the transit of small consignments the railway is much superior to

the canal; but this only proves the experience of Holland that the railway is an absolute necessity, even with the most perfect system of inland waterways which has yet been devised. Does the converse hold true, and is the continental experience that the maintenance of the inland waterways is a necessity even when an excellent railway system exists, applicable to this country also? I am strongly of opinion that it is, and that we cannot afford to ignore the supreme efforts which are being made by our competitors to cheapen transport.

The fact is, that in this country, as on the Continent, there are two descriptions of traffic. The one generally moved in bulk, of low value per ton, and in which speed in the matter of transit is of minor consequence, the other generally moved in comparatively small consignments, of high value per ton, or in which speed in the matter of transit is of great importance. Speaking generally, the difference in the two classess of traffic is the difference between raw materials and manufactured goods. For the carriage of the one the railway is pre-eminently fitted, for the carriage of the other the waterway is the more economical. It is significant that in England the manufactories in the neighbourhood of our great ports can be distinctly traced along the lines of the canals.

It is very plausibly argued that matters may be left to take care of themselves. Goods which can be more economically carried by canal will go by that route, and those which can be most favourably carried by rail will preferably go by that means of transit, and the fact that canal traffic languishes in this country is proof that it is not suited to our methods of trade.

Arguments of this kind leave altogether out of account

The Policy of the British Railway Companies with regard to Canals.

I believe this to have been based on an entire misconception of what was best for the interests of the community, and even of the railway companies themselves. From the start, the companies have regarded the canals rather as rivals to be crushed, than as useful auxiliaries to whom could be handed the traffic it would not pay to send by rail. Every trader is aware of the vast difference made in the rates charged by railway companies to and from towns with effective waterways, and to districts where these waterways do not exist, or have been rendered inoperative by neglect. Given equal rates, traffic will go by rail, as the saving of time, and convenience of dealing with small consignments, will always operate in favour of the railways. But as a consequence of the present policy of the railway companies the respective tonnage of goods conveyed to competing points by rail, or canal, is no criterion of the economic advantage of the two systems for a particular kind of traffic.

A case in point is the result of the improvement of the Severn navigation. In 1890, the Severn Commissioners went to Parliament, and obtained an Act, empowering them to raise £30,000, and to expend it in deepening the channel between Worcester Bridge and Gloucester, to a minimum depth of 10 feet at low summer level, and in other works of improvement.

These improvements were carried out between 1891 and 1894, and have not resulted in any great improvement of traffic, for the reason that the railway companies lowered their rates from the sea ports to Worcester and the towns on the Severn route, to a point at which they could retain the traffic which would otherwise have found its way by canal.

But the managers of railway companies must earn sufficient to pay a dividend to their shareholders, and the loss made by carrying traffic to competitive points at unremunerative rates is made up by charging higher rates than would otherwise be necessary to points where the railway has a monopoly, so that the community generally, suffers by the action of the railway companies in their endeavour to crush water-borne traffic.

In a paper handed by Mr. Conder to the Select Committee on Canals, which sat in 1883, an exhaustive analysis is made of the practical result to the railway companies of the low rates charged by them for certain descriptions of traffic. Mr. Conder estimated that in 1877, the loss to the shareholders of railway companies on the carriage of coal to London alone amounted to £822,000 per annum, and if this be correct the total loss to-day must be largely in excess of these figures. The heavy mineral traffic carried by the companies has necessitated an enormous capital expenditure in the duplicating and quadrupling of their main lines, and in the building of miles of sidings and station accommodation. It would appear, if the calculations of Mr. Conder are only approximately correct, that both railway shareholders, and the whole community, would be largely in pocket if the companies con-

fined themselves to the traffic which needs quick delivery and can bear comparatively high rates, leaving the traffic which can be more economically water-borne to that method of transport.

The determination of the railway managers to secure every description of traffic, even at a loss, has had the further effect of

Stopping the Improvement of the Water-ways.

Capital is not likely to be attracted when it is known that expenditure is likely to be made unremunerative by such a competition as that to which I have alluded. Although there are some exceptions, yet, speaking generally, the condition of our waterways is worse than it was seventy years ago; meantime the modern requirements of commerce have become more and more exacting, and no industry can possibly flourish which does not progress with the times, and in which improved facilities are not constantly provided.

An improvement urgently needed is a nearer approach to a uniformity of gauge on existing canals. Take, for instance, the communication between Birmingham and the Bristol Channel ports. One portion of this communication is *viâ* the tidal waters of the Severn, where it is not safe for small canal barges to navigate. As far as Worcester, 43 miles from Gloucester, river barges can be navigated with maximum dimensions of 135 feet in length by 22 feet in width, and a draft of 8 feet 6 inches, but for the 30 miles to Birmingham, the largest barge which can be accommodated is only 71 feet 6 inches in length, 7 feet in width, and drawing only 4 feet of water.

The consequence is that every bit of water-borne traffic between Birmingham and the Bristol Channel ports must be transhipped either at Worcester, or at Gloucester, and this necessity for transhipment causes not only great delay but a cost which is altogether disproportionate to the total cost of the journey.

Another difficulty is that of gettting

Through Rates on Canals,

any portion of which is owned or controlled by the railway companies. The Birmingham Canal Navigation consists of a network of canals 158 miles in length, which is controlled by the London and North-Western Railway Company. According to an authoritative statement made by the Birmingham Canal Company, the London and North-Western Railway Company, in 1846, agreed to pay in perpetuity £4 per share per annum on 17,600 shares then existing. These shares had cost altogether £645,000, so that the guaranteed payment amounts to 10½ per cent. on the capital invested. The local traffic on the canal amounted in 1898, according to the Board of Trade return, the last made, to 7,131,022 tons, but the through traffic was only 1,578,730 tons. The through traffic is in fact diverted to the railway company, and serves as a feeder to it instead of to the canals in connection. Every trader interested knows how this is effected.

What is to be Done.

The problem is a difficult one, but as business men we ought to face it, and settle it. I believe that the great majority of the trading community are of opinion that continental nations are right in the conclusion to which they have arrived that rail and water communication are both necessities. I believe that further the great majority are of opinion that the conditions under which trade is carried on in this country are not so different from those of the Continent as to enable us to treat our inland waterways with indifference, without our being handicapped in competition with our rivals abroad. We cannot forget that transit charges are an element in the cost of production, and the manufacturers in a country in which transit is cheap, and is conducted on the most economical lines, must be more favourably situated, other things being equal, than in a country in which transit charges are dear. Nor can we forget that if the railway companies charge rates, which involve a loss at competitive points, they must recoup themselves where they enjoy a monopoly.

If the railway carriage for a certain class of goods is more costly than water carriage, the community bear the whole of the loss even though the rates are the same at competitive points.

It has been suggested that

State Control

of canals will solve the difficulty, and a resolution was proposed by the Manchester Chamber of Commerce at the last meeting of the Associated Chambers to the effect that the time has arrived when the British Government should take under its control the whole of the canals of the country, and work them in the public interest, or as an alternative, place them in the hands of a national trust with a Government guarantee, supervision, and control.

Although it is true that these are the lines along which continental nations have moved, I believe that the conditions in this country are such that this proposal is outside practical politics, at the present time. Parliament is already overburdened with work, and to what Government department is it proposed to confide the necessary supervision and control? Is it the Board of Trade? Does the attitude of Parliament towards commercial matters entirely commend itself to business men? And is the Board of Trade as at present constituted an ideal institution to which to confide a matter of this kind? It must not be forgotten that even if a National Trust is called into being for the special purpose of dealing with canals, yet if it is to have the disposal of public funds, it must be under the control of some Government department, and of Parliament itself. But beyond considerations of this kind, there is one great difference between continental nations and ourselves which must be taken into account. Upon the Continent, for the most part, the harbours are made and maintained by the State: with us they have been made, and maintained, either by private enterprise or by municipal authorities. Is it proposed to transfer the British docks and harbours to the State? If so, has the magnitude of such a change and all that it means been considered by those who advocate State control of our canals?

If not, how are the conflicting and competing interests of our ports to be brought into harmony? The canals and the railways are the great feeders to the ports. Will Liverpool view with complaisance the expenditure of national funds to improve the port of Bristol? Will Southampton relish a large expenditure to which it must contribute its share for the improvement of canals which will tend to divert trade to London?

There is yet another question which demands consideration. The Manchester proposal is to the effect that the British Government should take under its control the whole of the canals in the country. It is useless to shut our eyes to the fact that there are some canals in existence upon which the possible traffic will never be sufficient to justify expenditure being made upon them. It is useless to attempt to work a system of waterway navigation between points where traffic is not likely to be moved in bulk, say in quantities of a minimum, as a general rule, of 20 to 25 tons. In districts where there is a considerable mineral traffic, or between the ports and the great centres of industry in the Midlands, canal traffic may be developed to economic advantage, but a sparsely populated district, or one along the line of which neither mines, quarries, nor manufactories exist is best served by the railway. The experience of Holland is to the point. It was there found absolutely necessary if districts of this kind were not to fall into decay, that rail communication should be provided even when an almost perfect system of waterways was in existence. Upon lines of communication, which are not fitted for the transit of goods in bulk, canals are not needed, and the land they occupy may be turned to more profitable account. What is necessary is to decide upon the points which may be economically served by waterways and to put these into a condition in which they may be turned to useful account.

I am of opinion that the problem can be best solved by powers being given to

LOCAL AUTHORITIES

to form canal trusts and to acquire and improve certain lines of waterways to serve local districts. Such a method of procedure would be in harmony with the whole system of legislation to which we have been accustomed. The canals are analogous to the highways. In continental countries the highways are generally maintained by the State, but in this country the roadways are maintained and controlled by the local authorities. Some of the great ports are entirely maintained by the municipalities; in others municipal authorities are largely represented on the Boards which control them. There is one important difference between the Continent and Great Britain, inasmuch as that in the one case the ports are comparatively few as compared with the inland population to be served, and are nearly all in the hands of one authority; in the other they are many, they are in hands of different authorities, and keenly compete against each other for business. I believe that the many conflicting interests of the British ports would be best served by allowing them to work out their own salvation in combination with the inland districts served by them.

Such a scheme was embodied in the Canal Traffic Bill, prepared by the Bristol Chamber of Commerce, adopted by the Canals Committee of the Associated Chambers, and brought into the House of Commons by Sir Henry Holland in 1901. The objects of this

Bill were to extend the powers conferred by the Board of Trade with regard to derelict canals under the Railway and Canal Traffic Act of 1888 to any existing canal, and to authorise the formation of public canal trusts. It would have empowered local authorities to combine to take over the management of existing canals, and to subscribe to the expenses of the formation or promotion of public canal trusts. It would have enabled canal companies to dispose of their undertakings to public canal trusts, and a canal trust was defined as any body of persons who are otherwise than for private profit entrusted with the duty or invested with the power of improving, managing, regulating, and maintaining a canal or navigable river.

The Bill followed the precedents set in the derelict Canal Clauses of the Act of 1888, in the Light Railways Acts, and in the Acts under which local authorities control, and maintain the highways, and its provisions were generally approved by the Board of Trade. Owing to the congested state of Parliamentary business, and the fact that it was opposed by the railway interest, the Bill did not get a second reading, and the same fate awaited it on its re-introduction in the sessions of 1902-3. The present state of Parliamentary business, is such that a measure introduced by a private member, if opposed, has a very remote chance of obtaining a second reading, still less of passing into law, and the commercial community have some ground for complaint that the Government did not give facilities for its passage.

On December 13th, 1900, a deputation from the Associated Chambers had an interview with the President of the Board of Trade upon the subject. Mr. Gerald Balfour, in the course of of that interview, said, "He had not heard it suggested that the Government should undertake the work of developing and managing inland navigation. He must dismiss that proposal—nothing was more alien to our general way of managing things in this country."

So far some of us may agree with the President of the Board of Trade, but he went on to ask for the submission of definite proposals upon lines similar to the Light Railways Act of 1896. "If," he said, "the Associated Chambers of Commerce would appoint a Committee of their own to draw up a scheme and embody it in a Bill the Board of Trade would give it careful consideration." With business-like promptitude the Chambers of Commerce accepted the challenge, and at their next meeting a strong committee was appointed consisting of representatives of London, Manchester, Birmingham, Wolverhampton, Cardiff, Oldham, Worcester, Bristol, Liverpool, Hull, Stroud, Belfast, Dublin and Greenock. This committee met and agreed to adopt the Bill to which I have alluded, as drafted by the Bristol Chamber. On May 12th, 1902, the Chambers again sought an interview with Mr. Gerald Balfour, who admitted the importance of the agitation, and promised to consult his colleagues in the Government, with a view to their acceptance of a second reading, on condition that the Bill be then referred to a Select Committee. We have been able to secure nothing further and are still waiting the redemption of Mr. Balfour's promise, and the answer of his colleagues. I confess that some of those who have taken an active part in this matter, would hail with pleasure the advent of a strong business man at the head of a department which is charged with the facilitating the business of a nation.

I would like to emphasise

The Importance of this Matter to the Midlands.

Warwickshire, Staffordshire, Shropshire, and Worcester, form a great manufacturing centre; their food and raw materials imimported from abroad must come to them through the ports, and cheap transport from the ports to the Midlands is of vital consequence to the great Midland industries. The amount of food stuffs imported into the district of which Birmingham is the centre, is about 700,000 tons annually, and a similar quantity of timber is also annually brought there. Added to this the Birmingham district imports something like 1,700,000 tons a year of copper, tin, lead, iron ore, and zinc. Roughly speaking, in food and raw materials, the district imports about 3,000,000 tons annually. Every shilling a ton saved means £150,000 saved to the ratepayers of the district, and this on the import trade alone.

At least I plead for

A Business-like Common-sense Manner of Dealing with the Question.

It is not business nor common-sense to pursue a policy of drift. It is neither business nor common-sense to complain of the severity of foreign competition, and at the same time to

neglect any means by which our manufacturers may be placed in a better position to compete with their foreign rivals.

It is neither business nor common-sense for a responsible statesman seriously to ask a body of business men, representative of our great trading interests, to spend time and thought in formulating a definite proposal upon a question of great importance, and when the proposal is made, to treat it with complete indifference.

I will go further, and say that in view of the strenuous efforts made by foreign Governments, it is neither business nor common-sense for the commercial affairs of the nation to be treated in the haphazard fashion to which we are unfortunately accustomed in this country.

The Secretary read the following letter from Mr. Philip Stanhope, M.P.:—

Dear Sir,—I regret extremely that I shall be absent in the provinces on November 30th, and therefore cannot be present on the occasion of the reading of the Paper by Mr. Arthur Lee upon the "British Canals Problem," as it is a subject in which I have long taken an active interest, having introduced into Parliament, during several successive years, a Bill to deal with the question, and having attended Canal Conferences on the Continent.

I confess I have been hitherto much disheartened by public apathy in the matter, which is nevertheless, of transcendent importance to our trade; but I am glad to see that Sir Michael Hicks Beach is about to give the movement his powerful aid and encouragement. Please express my regret to your Council.—Yours faithfully, Philip Stanhope.

DISCUSSION.

The Chairman, in opening the discussion, said that he did not profess to pose as an authority upon the question, and yet he could not say that he had not had some personal experience on it, and on matters more or less closely connected with it. He had had the honour for a good many years of representing the City of Bristol in Parliament, and that city had been pre-eminent in attempting to do for itself, at the cost of the ratepayers, an analogous work to that suggested by the author, namely, that of providing large dock accommodation for its trade, at the expense of many millions. He was a resident in the county of Gloucester, and the County Council of Gloucestershire had taken the initiative as a local authority in endeavouring to re-open for navigation the old Thames and Severn canal, which had practically become derelict for many years. That had been done at an expense which he was afraid had led to grumbling on the part of many ratepayers, although he did not think it had been at all extravagant, but it was yet too soon to prophecy as to what the results of the work would be. He had also been President of the Board of Trade, and as an ex-president of the Board of Trade he ventured to deprecate the strictures on the present holder of that office which had been passed by Mr. Lee. He knew better than the author the difficulties of anyone holding that office in obtaining time from the House of Commons for the consideration of the matters which he might desire to bring before it; and it did not at all follow that because Mr. Gerald Balfour had not been able to take any active steps in the matter now under consideration, that he was not in sympathy with the proposals suggested in the paper, or would not do his best to endeavour to carry them into effect. He (the Chairman) did take some steps in the matter as President of the Board of Trade. Sixteen years ago he was responsible for carrying the Railway and Canal Traffic Act through Parliament, an Act containing many clauses dealing with canals. It empowered the Railway Commissioners to fix through-rates for different canals in the public interests; it empowered them to prohibit unreasonable rates on canals fixed by railway companies interested in those canals, and endeavouring to divert traffic from the canals on to their railways; it forbad any railway company or a director or officer of any railway company from obtaining an interest in a canal, unless through special authority given by a special Act of Parliament; and it enabled canal companies to institute a clearing house for canal traffic precisely in the same manner as the Railway Clearing House which existed to-day; in fact it brought the tolls of canals under the jurisdiction of the Railway Commissioners precisely as the rates on railways were brought under their jurisdiction. Finally, where a canal was derelict, or practically in a condition which made it impossible to carry traffic over it, it enabled the Board of Trade to relieve shareholders of all liability of that canal, and to transfer it to a local authority, or to another body of persons who would undertake to put it and maintain it in good order. So that he thought it would be seen that as long ago as 1888 he not only had the question under his cognisance but also took steps which in those days were considered of importance towards improving the inland navigation of this country. He was afraid the result had not been what they hoped and perhaps anticipated; he was afraid the inland navigation of this country was not now in a condition such as they might desire. The author in the first part of the paper compared the action of other countries with our own. He thought in all such matters it must be remembered that, whether rightly or wrongly, it was the practice in this country to leave everything as much as possible to private enterprise, and it was the practice in continental countries to undertake everything as far as possible by the State. Two different systems had to be dealt with, and he did not

think it at all followed that, taken as a whole, the English system was wrong. What were the results? During the last forty years France was stated, by the author, to have expended, or to be intending to expend, about 55 millions upon inland navigation and harbours; Germany, 47 millions; Holland, 17 millions; and Belgium, 16 millions; and he was afraid, with the exception of a very considerable improvement in the navigation of the Thames, no important work had been done in this country in regard to inland navigation, except the Manchester Ship Canal. What were the reasons for that state of affairs? In the first place, the circumstances were not quite the same, as the author admitted. England was not favoured with those great natural waterways which continental countries possessed. In proportion to its area he thought this country was a more hilly country, and therefore less favourable to the construction of canals than the plains of France or Germany, or the flat levels of Holland. But there was something more than that. England was infinitely better supplied with railway accommodation than any continental country, and he should say a greater proportion of the traffic of the country was traffic which would not go by canal, and was essentially railway traffic than in the countries which had been named. Our passenger traffic, the small consignments of goods which formed so large a part of English trade, and perishable and valuable goods would not go by canal, and he thought it would be found that articles of that description formed a larger proportion of the total traffic than they did in the countries with which comparison had been made. Therefore the circumstances were not quite the same. Further, it must be remembered that some of the expenditure in the countries which had been quoted, was not expenditure on inland navigation but on harbours, and he was quite sure that nobody would contend that England had been remiss in that kind of expenditure in recent years, or that we had not expended on our harbours, in different parts of the country, quite our fair share of the world's expenditure under that heading. But, making allowance for everything of the kind, there was unquestionably a most important difference between the way inland navigation had been treated in England in the last 40 years, and that in which it had been treated in continental countries; and he was prepared to associate himself with the author's words, when he said that we could not afford altogether to disregard the experience of our continental rivals on the subject. The influence of cheapened transport by sea had been immense on the fortunes of the world in the last 50 years, perhaps greater on the fortunes of this country than on the fortunes of any other country, and if it were possible for England, at any reasonable cost, to obtain cheapened transport by land for its industrial products, he was bound to say he thought it would have a very important influence upon the future of the country. The author had very ably grappled with the question of what could be done. Mr. Lee demurred, not perhaps on the ground of principle, but on the ground of its practicability, to the proposal which had been made in many influential quarters that the State should assume the control and ownership of all the canals at the cost of the ratepayers, that it should institute a great system of inland navigation, and should place the canals at the disposal of persons desiring to use them absolutely free from tolls, just as the roads were. He knew something of the House of Commons, and he was absolutely certain that they would no more obtain the assent of the House of Commons to a proposition of that kind than they would to the most impossible proposition that anybody present could conceive. It was not merely that it would be very strongly opposed by an extremely powerful interest, the railway interest, who would say, with some reason, as the author had suggested, that when Parliament had allowed and encouraged them to spend many millions in perfecting their system of railways, it would be a little hard that the public funds should be utilised in order to establish a system of canals to compete with them—but it must be remembered that there were persons in this country (and he thought an increasing number of persons, although perhaps the advocates of the change were not among them), who did feel the burden both of taxation and rates, and the influence of those persons on the House of Commons would be such that he was quite certain it would never entertain a proposal of the kind. If that were impracticable, what was the alternative? The author had put forward an alternative based on the section of the Railway and Canal Traffic Act of 1888, extending that section which now affected only derelict or practically useless canals, to all canals, and enabling them to be taken up by local authorities, either singly or combined, for that purpose. That was a practical proposition which he thought certainly deserved the consideration of Parliament. He did not himself believe that it would lead to the re-opening of all their canals—he did not think it ought to. Take, for example, the Basingstoke Canal, for which nobody would give anything the other day; it would be unreasonable to expend the money of the ratepayers in attempting to re-open that canal for public purposes. He knew a canal in the north of the county of Wilts, which, at the present time, was practically useless, and on which he thought no reasonable person would propose that public money should be expended in order to restore it for purposes of navigation, and there were many similar instances in the country where he was quite sure local authorities would never dream of availing themselves of such powers if they were entrusted to them. But there were cases where it would be possible for local authorities to benefit their districts very greatly indeed by some expenditure of the kind. The author had referred to the great producing district of the Midlands of which Birmingham was the centre, and which naturally desired means of communication with the sea; he had said that there was a line of waterway from Birmingham

to the Bristol Channel ports, but that practically it was rendered useless because the canal between Worcester and Birmingham was so small that it would only admit barges of very small dimensions. If the whole of the waterway were made capable of accommodating vessels of the size which now could go right up to Worcester from the sea, surely that would be a means of competition with the railway system from Birmingham to the coast, which might be of enormous advantage to the trade of Birmingham and the midland districts. Other examples in the country might be found where a judicious expenditure on the part of the local authorities, either singly or in combination, might enable the waterways to be completely utilised, instead of being comparatively useless, as they were at the present moment. He ventured to suggest that if it were possible to approach the matter on such lines, more practical good would be done than by a far larger scheme, such as he had already referred to. If they could get one step towards the attainment of their object, something would be secured; while if they insisted on a great scheme, which he did not for a moment believe could be carried, they were simply postponing any advance in the desired direction. No one could overrate the importance of the matter to the country, and the author had dealt with it with an ability and moderation, which must excite all their sympathies.

Sir JOHN BRUNNER, M.P., after thanking the Chairman for supporting the author's project, which he considered was of very great value, said he hoped that even although at the beginning, the brave experiment made by the Gloucestershire County Council might not succeed, if they obtained a good through rate from Gloucestershire to London their expenditure might prove hereafter to have been an extremely wise one. The Chairman had stated that the Act of 1888 had been up to the present time almost inoperative, but it was hardly to be expected that as long as canals continued in their present condition, differing in gauge as they did so many times on a long journey, any advance would be made. Nevertheless the Act of 1888 was still considered of importance, and only last session a concession was obtained from the railway companies under the Act. The Chairman had spoken of the practice in this country of leaving all public work to private enterprise, and had given him the impression that he was entirely hopeless of making any changes. The doctrine of *laissez faire* under which they had acted hitherto became fashionable at the solicitation of the free-traders of the forty's and fifty's, who, telling the nation that they wanted to be left alone, imposed the idea upon the imagination of the people to such an extent that they had been unable to shake it off; but he hoped the example set not only by all the nations of Europe, but by every colony of Britain in the world, would induce them to change their system. There was no doubt that the canals, no matter what they did with them, would play a humble *role* as compared with the railways, but nevertheless he had hoped that the business men of the country, and the Government following the business men, would help the canals to perform that *role* to the best advantage of the nation. The author had given irrefutable reasons for taking a step in advance. He had mentioned what had been done by Austria-Hungary, and it was interesting to remember that the Minister who had done most to promote inland navigation recommended his policy as being the one which would divide the people of the country the least, and because it would calm down racial differences. He hoped the policy the author had suggested, which was a policy of all for all, might tend to diminish political differences amongst them. Mr. Lee had stated that a good many of the Canal Commissioners at the time of the great extension of railways in the forties actually insisted upon the railway companies buying them up, in spite of the fact that they were doing very good business. He was in a position to state that he believed the Manchester and Liverpool Chamber of Commerce at the next meeting of the Associated Chambers next March, would not demand, as they did at the Manchester meeting, that the Government should buy up all the canals, but would recommend that it should have the power to buy such canals as it thought should be bought in the interests of the country. He hoped the House of Commons would shortly mend in its treatment of such matters, and that it would not push aside with cold indifference any demand on the part of the mercantile community for State aid. If the mercantile community would only make up its mind what it wanted, and ask for it, he believed they would get it. He was an advocate of unity of ownership, but the author was afraid that local jealousies would prevent progress. In his opinion it would be a mistake to allow local jealousies to influence their actions, and they would be wise if they made the control and ownership central in order that the real consideration daily before the minds of those who managed the concern should not be local interests but the general interests of the community. The Chairman thought it was Utopian, but he (Sir John) did not think it was true economy to refuse to spend money when it was known that the money would bring in a good result; and therefore he should not think it wise on the part of any section of the community to refuse, on the plea of economy, to proceed in that direction. He was satisfied that the people of the country would gain very greatly indeed as a community and as an Empire if they made up their minds to proceed on the lines France had taken.

Mr. L. F. VERNON HARCOURT said he had visited the canals in the different countries which had been mentioned. On the French waterways it would be found that the traffic was large in some parts of the

country and small in others, the heavier traffic occurring where there was a great amount of bulky goods. The same remarks also applied to Belgium and Germany. It must be remembered, in discussing the question, that the rivers in continental countries were much larger than those in England, and that, therefore, the connections between the rivers were of much greater importance, while the lines of communication were considerably larger than in this country. Nevertheless, he did not think the canals of the country should be neglected as they had been in the past. One or two waterways had maintained their position and held their place with success against railways, notably the Aire and Calder Canal and the Weaver Navigation. But canals for large traffic did not depend so much upon the goodness of their waterway as upon the presence of bulky goods. The waterway from Birmingham to the Severn, *viâ* Worcester, although it was a short one, was a bad one. He thought it would be possible to make a beginning there, and he could not understand why the people of Birmingham had not carried it out. He agreed with the author and the Chairman that it would be impossible to buy up the whole of the canals of the country; the suggestion that that should be done had tended to delay the improvement of certain waterways, owing to the impossibility of improving all the waterways whether they gave a return for their traffic or not. It would be a great advantage if, as Mr. Lee suggested, the different ports had powers granted to them to improve the waterways communicating with them. The Board of Trade had been found fault with. He thought it would be advisable that the control of the canals should not be under the assistant-secretary for railways, but under an assistant-secretary for commerce or harbours, because more interest would be shown in the undertaking if it was in the hands of those who had similar matters to deal with.

Mr. E. PARKES, M.P. (Birmingham), said it appeared to him that if the question under discussion could be satisfactorily settled it would go a considerable way towards settling the question of foreign competition, especially in the Midlands. Everyone agreed that the author had made out his case; the question in dispute was the remedy. There were two propositions before the country, nationalisation and municipalisation. At the time Mr. Lee brought the matter before the Chamber of Commerce, municipalisation was the plan which was more or less favoured; but he (Mr. Parkes) reminded the meeting that if the Bill suggested had been passed it would only have been a permissive Bill. The result would have been that the same divergence of opinion, the same jealousies, the same impossibility of the committees to find money or pledge their rates for the purpose of developing this or that canal would have existed as before the passing of the Act, and it was that which was the great bar to the accomplishment of the object in view. The Town Council of Birmingham appointed a committee which went into the matter most thoroughly, particularly with regard to improving the waterway between Birmingham and the Bristol Channel ports. Why was nothing done? Birmingham people raised the objection that while the traffic between Birmingham and London and Liverpool represented 90 per cent. of the trade of the town, the trade with Bristol represented only 3 to 5 per cent. Birmingham wanted a scheme which would improve the connection with Liverpool and London. Sir Alfred Hickman brought forward a proposal for enlarging the existing canals at a cost of between three-quarters of a million and one million pounds, which sum was to be raised by pledging the rates, not only of Birmingham, but of the surrounding districts, representing a population of two or three millions, to the extent of 2d. or 3d. in the pound, but the whole of the municipalities refused to accept the proposal. The business communities of the country would be devoutly thankful to any Government of whatever party which would take the matter in hand. He believed that if the Bill suggested by the author was passed they could hope for very little indeed from the municipalities. In the case of the canal between Birmingham and London or Liverpool, all the municipalities, boroughs, and counties along that route would have to be taken into consideration. It was said at the Manchester meeting that the general opinion had veered round from the municipal to the national point of view. It appeared to him that the national point of view would be the most feasible and the most workable, because all the different conflicting interests which he had referred to could thus be harmonised; but the Chairman had said there was not the remotest possibility of Parliament taking it up, and as the municipalities would not take it up, they had arrived at an *impasse*. A strenuous effort should be made to overcome this *impasse* by harmonising the different views at present existing, so that a united appeal by all concerned could be made to the Government to take the matter in hand.

Mr. G. WESTALL regretted that the author had not given more statistics with regard to the traffic of some of the principal canals in order that a comparison might be made with the traffic on some of the practically derelict canals. He had also expected that Mr. Lee would refer to the rivers which were the feeders of the canals. Some years ago he interested himself in endeavouring to reopen a carrying business between London and Oxford, but he found that the navigation of the Thames was extremely bad, the depth of water in some cases not exceeding three feet; but the greatest difficulty arose because of the extremely bad arrangements that existed in the port of London for the collection of goods. Probably a whole week would be spent in collecting goods deposited in different docks in order to get a full freight for one barge; and the extremely shallow state

of the river made navigation impossible in some cases. He remembered the time when the canals of the country decayed not altogether because of the competition of railways, but because of their own defects; they were so small that they could only carry such freights as made it impossible to realise any profit. In the case of the Birmingham and London Canal, there was a good waterway for 80 miles through the Grand Junction Canal, with 14 feet locks, but for the remainder of the distance the locks were only 7 feet wide, necessitating the employment of boats which must not carry top loads. He thought it would be perfectly useless and throwing away money to acquire many of the existing canals; no proposition was worth considering which did not provide a canal capable of taking a barge conveying 250 tons weight.

Mr. B. I. BELISHA said he came from Manchester, the Mecca of inland navigation in this country. It was very unfortunate that whilst so many able and thoughtful men were agreed that something was necessary to be done, there should be a division of opinion as to ways and means, but he did not think the differences were so irreconciliable that after mature consideration a *modus vivendi* could not be adopted. A policy was required that would unite the people of the country the most, and the paper would go a long way in educating public opinion on the question. There were such difficulties both with regard to the nationalisation and municipalisation of the canals, that for a time an effort must be made to combine and adopt a middle course, as suggested by the author. There was, no doubt, an advantage in public authorities dealing with the question, as was evidenced by the City of Manchester lending at the critical moment five million pounds for the completion of the Manchester Ship Canal, which had been and would be an immense advantage to the whole of the community of the country. If the policy suggested by the author was to be adopted, a beginning must be made somewhere, and there was no better place in which it could be begun than in Manchester.

Mr. MARTIN WOOD thought the question was one of urgent national importance from the point of view of competition with continental countries. As the author had said, no improvement had taken place in water communications in this country for 70 years, and it was high time something was done to put the manufacturers of the country in a position to compete on more level terms with their continental rivals.

Mr. P. E. GAUNTLETT (Basingstoke Canal) said that after having giving the subject of canals the deepest consideration for many years, he agreed with the Chairman's method of dealing with the problem. If anything was to be done it must be done in a permissive way, giving the County Councils power to purchase canals as they thought proper. The Chairman had also pointed out why Holland had succeeded and England had failed. Holland was flat and there was an abundance of water, while the tolls on the canals were so low that they defied effective railway competition. One of the principal difficulties in England was the difference in the gauge of the canals. If money could be obtained to improve the various undertakings he believed a new system could be set up which would be of great advantage to the trading community. No one had touched on the most important subject of all in dealing with canals, namely the question of water. Water evaporated so quickly in the summer on some of the canals that it was impossible to run a barge. The Chairman had referred to the unfortunate Basingstoke Canal. It was quite true it had been unfortunate, but the cause of that was that it had been mismanaged. There were great possibilities in front of the Basingstoke Canal, only it required a man of courage with a little money to make it a success.

Mr. LEE, in reply, said that he was a plain, practical business man, and he only wanted that which was practical. If the gentlemen who advocated State control of canals would only put their views on paper, and try to elaborate a Bill under which their ideas would be carried into effect, he would be exceedingly glad to see it; but he believed when they did sit down and put their pens to paper they would find out what the difficulties in the way were. He presumed that, as Mr. Parkes had suggested, it would be a compulsory measure, and he was rather curious to know how they would suggest obtaining by compulsion from the railway companies the canals which they had been compelled to take up under pressure from the canal companies themselves. He was very pleased that Mr. Parkes had come down from Birmingham, because he hoped that gentleman would go back as a missionary to his district, which needed a missionary very badly. More cold water had been thrown upon the project in Birmingham than in any other town. He would like Mr. Parkes to tell his friends in Birmingham that although it was perfectly true the great majority of the exports of Birmingham went *viâ* Liverpool and London, yet 35 per cent. of the imports came from the Bristol Channel ports, and the committee, to which Mr. Parkes had alluded, seemed to have forgotten altogether the importance of the import trade, which to Birmingham was of greater importance, as far as canal communication was concerned, than the export trade itself.

The CHAIRMAN, in proposing a vote of thanks to Mr. Lee for his able paper, said he had gathered in the course of the discussion that the representative of the Basingstoke Canal was obliged to admit that private enterprise would not provide the necessary capital to place the undertaking in proper order, that one of the representstives of

Birmingham in Parliament said there was no hope from municipal enterprise, and the conclusion, therefore, appeared to be that they must come upon the taxpayers of the country generally. He had some Treasury instincts still left in him, and he rather deprecated that conclusion. Sir John Brunner had his best wishes as to the future, but he was sure that gentleman would not forget that when the Government which he desired took office one of its first pledges was reduction in the expenditure of the country.

The resolution was then put and carried unanimously.

BRITISH WHEAT SUPPLY.

If in the early days of the last century it had been predicted that at its close the population of the United Kingdom, which in 1800 was not much over 16,000,000, would exceed 41,000,000, whilst the area under wheat cultivation would be less than 2,000,000 acres, the one forecast would have found few to accept it, and the other would have been received with derision. It was taken as axiomatic that just as the high prices ruling at the time resulted in the agriculture of the country advancing with rapid strides, so great increase in population, and a greater individual rate of consumption consequent upon increased wealth and altered habits, would keep prices at a profitable level, and foster the growth of wheat. Up to 1874-5 this is pretty much what happened. The abnormal prices of the great war passed with it—in 1813, the price of wheat was £5 9s. 9d. per quarter, in 1816 it had fallen to £3 18s. 6d.; but land—the raw material from which food is produced—being limited in amount, and in increasing demand, necessarily rose in price. So much was this the case, that whereas the average price of wheat for the five years preceding 1875, was £2 15s. per quarter, as compared with £5 2s. 6d. for the five years preceding 1815, the rent of land was much higher in 1875 than it was in 1815. It is during the last thirty years that we have seen the anomaly of population and wealth increasing rapidly whilst the area under wheat steadily decreased. The following figures make this clear:—

AREAS OF CEREAL CROPS IN THE UNITED KINGDOM.

1875.

	Acres.
Wheat	3,514,088
Barley	2,751,362
Oats	4,176,177
Total	10,441,627

1900.

	acres.
Wheat	1,901,014
Barley	2,172,140
Oats	4,145,633
Total	8,218,787

These figures show that the area under wheat shrank in the twenty-five years by nearly one half. Nor was the land taken from wheat cropped with one or both the other cereals. The acreage under barley shows a shrinkage of about 22 per cent., and the acreage under oats is less. And yet in the interval the population had increased by nearly 10,000,000! Since 1900 the acreage under wheat has continued to diminish. The preliminary statement of agricultural returns for Great Britain for 1904 gives the wheat acreage at 1.375,284 acres, as compared with 1,581,587 for 1903. The total quantity of wheat estimated to have been grown in Great Britain in 1904, amounting to 36,880.246 bushels, is the smallest crop on official record. The shrinkage in the last three years is shown in the following figures:—

	Bushels.
1902	56,676,783
1903	47,642,816
1904	36,880,246

It was assumed by Caird and others that the advantage of position would always give the British farmer a great advantage over the foreigner, but experience has proved it to be somewhat illusory. The Kansas or Minnesota farmers' wheat does not have to pay for carriage to Liverpool more than 2s. 6d. to 7s. 6d. per ton in excess of the rate paid by a Yorkshire farmer, and the difference does not go far towards enabling the latter to pay rent, tithes, rates, and taxes. In 1872 the imports of wheat and flour into the United Kingdom were only 9,469,000 quarters, in 1900 they had increased to 23,196.000 quarters, and bearing in mind the figures as to acreage in cultivation given above, it is clear that with the continued growth of population the imports of foreign wheat must continue to increase.

The world is our granary, but there is much shifting in the sources of supply. Thus in 1872 Russia sent us more wheat than any other country. In that year our chief supply was obtained as follows:—

	Qrs.
Russia	4,168,000
United States	2,030,000
Germany	910.900
France	660,000
Egypt	536,000

Here we have Russia supplying more than twice as much as the United States, and neither India nor Argentina represented. In 1900 the position was very different.

	Qrs.
United States	13,561,000
Argentina and Uruguay	4,322,300
Canada	1,877,100
Russia	1,031,700
Australasia	883,900

The imports from Germany and France had become insignificant, and Egypt had dropped out. Russia had fallen to fourth place, the United States supplying more than half of the total import of 23,190,800 quarters.

Coming to the present year, we find another great shifting. The following figures are taken from page 28 of the Trade and Navigation Returns, giving the imports of wheat into the United Kingdom for the ten mouths, January-October, 1904 :—

	Cwts.
British East Indies	20,469,100
Argentina	18,466,700
Russia	16,827,100
Australasia	9,268,400
United States	6,541,100

It would not be safe to base definite conclusions on the figures of the ten months of the present year given above, but it may be taken as certain that in future we must look to other countries than the United States for our chief wheat supplies.

In his presidential address before the British Association for the Advancement of Science (1900) Sir William Crookes gave it as his opinion, that "It is almost certain that within a generation the ever-increasing population of the United States will consume all the wheat grown within its borders and will be driven to import like ourselves." It is difficult to believe that men of forty may live to see the United States importing wheat, but they may well live to see an end of American (U.S.) exports of wheat. Americans whose opinions are entitled to great respect take this view of the matter. For example, Mr. James J. Hill, speaking at Minneapolis in January of this year said:

"There was a time when our popular campaign song was, 'Uncle Sam is rich enough to give us all a farm.' To-day he has not any farms to give us that we can cultivate. All of the agricultural land that can be cultivated without irrigation is gone, and the people are selling their houses in the United States and moving out into North-Western Canada, west of Winnipeg, where they can buy land from 6 dols. to 10 dols. per acre. More people have gone there than many of our men would like to acknowledge."

That may be an exaggerated statement of the case but it is significant to find a leading agricultural journal in New York State asking "Whether we have not reached the end of our era of wheat exportation; whether perhaps we are not approaching the time when we shall become importers instead of being exporters of this staple." And the writer goes on to point out that "There are forces at work that must ultimately cut off our exports of wheat, and will certainly, in time, render us unable to raise our own supply. One of them is the tendency of the American farmer to shift from wheat to Indian corn. This is really an advance from primitive to complex agriculture, for corn means cattle and other live stock; the marketing of meat instead of grain; the return of fertility to the land. Thus wheat exhausts the soil, corn (fed to live stock) restores it; new land only can grow wheat at a profit." Moreover, America has to meet the serious competition of other wheat-producing countries, and to sell her wheat at prices determined by international considerations, and not simply by the quality of her own harvests.

Losing our wheat supplies from the United States, can we reckon upon full supply of our wants from other countries? There seems little reason to doubt it, but it is not likely that the British East Indies will continue to head the list as it does for the past ten months. In 1900, India was unable to export a single grain of corn, but in normal years the imports from that quarter should be large. In a lesser degree, we must reckon with fluctuations in the Russian supply. The following figures indicate the extent of these fluctuations in the last four years :—

	Cwts.
1901 (12 months)	3,487,400
1902 (10 months)	4,118,684
1903 (10 months)	13,036,203
1904 (10 months)	16,827,100

Notwithstanding the war, Russia has sent us in ten months of 1904 nearly five times as much wheat as we received from her in the whole of 1901; but it may be taken that, owing to the war, the imports of Russian wheat in 1905-6 will show a great falling off. So with Australasia. Drought plays havoc. In 1903 we received 26 cwts. from Australia and 4 cwts. from New Zealand, in all from Australasia 30 cwts. In 1901 we got none from Western Australia, and none from Queensland and Tasmania. In the ten months of the present year to October 31 we have received 8,959,800 cwts. from Australia and 308,600 cwts. from New Zealand. The imports from Argentina may be expected to increase, but the farming industry in the Argentine Republic is not on a satisfactory basis. The farmer often has no interest in the land beyond the growing crops, a percentage of the harvest being the rent charged by the owner of the property. Little attention, too, is paid to methods of cultivation, as the farmer has no resources to help him if the cereal crops fail. Still, when the supply fails in one quarter, it is pretty safe to count upon its being made good in others, for the sources of supply are constantly broadening.

Probabilities point to the Dominion becoming in the course of the next few years our greatest and steadiest supplier of wheat. Few on this side have any accurate idea of the enormous wheat-producing capacities of that great country. In the quality of its produce, in the yield per acre, in the quantity of farming land available, in the prices of farming land, in the matter of Government assistance, in facilities for

marketing, in the general conditions under which farming is carried on, Canada, by the authors of that valuable little book, "Canada and the Empire," has already a striking advantage over the United States. Messrs. Montagu and Herbert quote official figures to show that the Dominion may be in a position within comparatively few years, after supplying all home demands, to furnish Great Britain with all the wheat and flour she requires and leave a surplus for export to other countries. The conclusion is arrived at in this way. Putting the imports of wheat and flour into Great Britain as equivalent to about 200,000,000 bushels of wheat, were one-fourth of the land said to be suitable for cultivation in Manitoba and the three Provisional Territories under crop with wheat annually, and the average production equal to that of Manitoba for the past ten years, the total crop would be over 812,000,000 bushels. This would be ample to supply the home demand for 30,000,000 of inhabitants (supposing the population of Canada should by that time reach that figure), and the present requirements of Great Britain three times over. And it is well to bear in mind that Canadian flour is the finest in the world, better even than the best brands of Hungarian, if we have regard to the quantity of albuminoids in it. Of course, the extension of the wheat area depends upon labour, and until recently the population of the Dominion grew but slowly. Of late, however, immigration has increased enormously, eightfold in eight years. The "American invasion," as it is called, commenced in 1896, and in 1903 sent to Canada 47,000 settlers. In 1903, the immigrants numbered 124,000, as against 67,000 in 1902, and 49,000 in 1901. It must be some years before the Dominion takes the place, so long held by the United States, as our chief granary, but there can be no reasonable doubt that our wheat supplies from the Dominion will rapidly increase, and that by the time the supplies from the United States altogether fail, the Dominion will have gone a considerable way towards making up the deficiency, whilst Argentina, India, and (if peace comes soon) Russia will pour in supplies that will prevent any very serious rise in the price of wheat, though we are not likely to see it again any where near the ruinous figure at which it was quoted in 1894, namely £1 2s. 10d.

NEW SOUTH WALES TIMBERS.

Mr. J. H. Maiden, F.L.S., has published at Sydney (under the authority of the Minister for Lands), "Notes on the Commercial Timbers of New South Wales," from which the following remarks are taken:—

Forest Wealth of the State.—I have no desire to use the language of exaggeration, but I can safely say that New South Wales is one of the most richly-endowed countries in the world as regards its forest wealth. I should be sorry to say that our timber supplies are unlimited—far from it; but, with our small population, we have large areas of practically virgin forest, and, in many places, as the trees are cut out, numbers of young trees are coming forward and flourish without hindrance, thus ensuring the stability of the supply of many of our timbers.

With few exceptions, most of our trees require no artificial replanting; what is simply required is conservation—protection of the young growth from damage by animals, fires, &c., and, in certain cases, what is called "thinning," which consists in destroying or weeding out sickly, malformed, or overcrowded saplings. Conservation should be our watchword.

Most of our valuable timbers are found in the coast and coast-mountain districts. A few, *e.g.*, the cypress pines of the western districts, and the ironbarks of Dubbo (and thence to the north-east) are found in the drier parts of the State.

The commercial timbers of this State are now being depicted by the author of this pamphlet in a handsome quarto work, "The Forest Flora of New South Wales."

The eucalypti are also specially and more fully dealt with in a work written by him, and entitled "A Critical Revision of the Genus Eucalyptus."

Supply of Good Timbers not Unlimited.—The demand for our timbers has been so active during the last few years, and fashion has set in almost exclusively for a very few species, that a word of caution is necessary. We have large quantities of excellent timber—there is no doubt of that; but not so much that we can afford to cut recklessly, and neglect conservation of young growths. We must not forget that the giant trees, the monarchs of our forests, which have yielded large quantities of high-class timber, are being rapidly cut out. They have been maturing their timber through the ages, practically uninterfered with by the aboriginal lord of the soil, and are no more to be replaced than can the nuggets which man can do nothing to produce; he simply reaps a harvest which he has not sown. The cutting out of forest without replanting or conservation of young forest growths is simply living upon capital, and, continuing the metaphor, we should seriously ask ourselves if we are establishing an adequate sinking fund.

Timbers for Export.—As regard the export trade, as the merits of our hardwoods become more fully realised, a largely increased demand may reasonably be expected to set in for them. Our soft pine may, perhaps, be utilised for butter-boxes. Our figured brush timbers have to win their way to recognition in the world's markets. This will necessarily be slow, but we have much valuable evidence as to their merits to encourage us to make them more widely known.

Timbers are only exported, as a very general rule, from the coastal strip. We have, however, a number of useful timbers whose use is local for reasons of transport.

Too great care cannot be exercised in seeing that timber which is sent to market, and particularly that intended for export, is not only good of its kind, but

also belongs to a species of acknowledged merit. In the cases of trees or timbers which bear a resemblance more or less strong to valuable timbers, the greatest care should be exercised.

Merits of many of the Timbers as yet unknown.—A number of our timbers are being tested as regards their suitability for wood-carving, and there is reason to suppose that we possess a fair number of timbers useful for this purpose. My own feeling is one of regret that the art of wood-carving has been so neglected in this State, as it is a specially useful art, and, as time rolls on, a considerable amount of employment will be available, both to men and women carvers of decorative work, for fittings of buildings, furniture, &c., to say nothing of more purely art objects for the decoration of the home, &c. And not only will wood-carving prove a remunerative occupation for many people, and a useful accomplishment for persons of leisure, but it will be the means of drawing public attention to the texture and properties of our native timbers, and of utilising some of those which at the present time are put to no particular purpose.

In the second part of his report, Mr. Maiden gives a classification and description of the commercial timbers of the colony, and in the third part, a list of the timbers which can be used for special purposes, ending with the following notes on wood paving and wood pulp :—

Wood Paving.—May I, at this place, insist that timbers of a kind should be kept together in wood-paving? No two timbers are of such similar texture in all respects that they wear absolutely equally when formed into a roadway. A road engineer would never dream of laying together stone cubes of various materials. The irregularity in wear of a wooden roadway is especially detrimental, and I desire to raise my voice against the pernicious doctrine that our timbers may be mixed in the same stretch of roadway. There is no excuse for mixing them, as they can be readily separated by any man who has devoted some attention to the subject, and timbers not of the first class would stand a better chance of useful employment if they formed strips of roadway by themselves.

Wood Pulp.—It is desirable to ascertain whether any of our timbers can be utilised commercially for pulp in paper-making. This investigation must be preceded by determination of the cellulose in our timber.

OPTICAL CONVENTION, 1905.

The Optical Convention will be held in London at a date towards the end of May, 1905.

The President is Dr. R. T. Glazebrook, Director of the National Physical Laboratory. The list of Vice-Presidents includes Sir William Abney, Lord Blythswood, Sir W. H. M. Christie, Astronomer Royal, Earl of Crawford, Lord Kelvin, Lord Rayleigh, and the Earl of Rosse. The Treasurer is Mr. E. B. Knobel, and the Honorary Secretary Mr. F. J. Selby.

The main object of the Convention is to bring into close sympathy and co-operation men interested in optical matters, from all sides of the question, theoretical, practical and commercial. This it is proposed to do by holding a series of meetings for papers and discussions on optical questions; and a "Papers" Sub-Committee has been appointed with Prof. S. P. Thompson as chairman, and Mr. S. D. Chalmers as secretary.

It has also been decided to organise an exhibition, of a scientific character, of instruments manufactured in this country, with a view to showing the great progress recently made and of stimulating further efforts.

Instrument makers and manufacturers are invited to assist the committee by sending for the purpose of the exhibition typical instruments and apparatus of their manufacture. It is not proposed to ask exhibitors to pay for space, but a nominal sum, to defray out of pocket expenses, would be charged to each firm whose goods are shown. This charge would not exceed one guinea for each class in which goods are exhibited.

An illustrated catalogue will be prepared, which will describe the special character and advantage of any particular instrument. It is hoped that the catalogue may be especially serviceable to manufacturers in making their instruments known in colonial markets. An Exhibition and Catalogue Sub-Committee with Dr. Mullineux Walmsley as chairman, and Mr. F. J. Selby, as secretary, is already at work. A provisional list of classes which they have drawn up for the exhibition and catalogue is appended. Firms desiring to have their manufactures included in the catalogue, or to send apparatus for exhibition, are requested to communicate without delay with the secretary, and to forward as early as possible descriptions and particulars of their instruments.

The following is the suggested classification of instruments:—(1) Materials and tools; (2) simple optical elements and testing apparatus; (3) astronomical instruments; (4) nautical instruments; (5) surveying instruments; (6) meteorological instruments; (7) spectacles and eye-glasses; (8) telescopes and binoculars; (9) microscopes and accessories; and apparatus for photo-micrography; (10) photographic apparatus; (11) projection apparatus; (12) apparatus for optical measurement—spectroscopes—refractometers—polarisation and interference apparatus—apparatus for measurement with optical aids; (13) photometric apparatus; (14) heliographs—range-finders; (15) stereoscopes; (16) ophthalmic instruments and appliances; (17) apparatus for educational purposes; (18) mathematical and drawing instruments—calculating apparatus; (19) shop fittings and miscellaneous; (20) historical collection; (21) literature.

OBITUARY.

GEORGE VIVIAN POORE, M.D., F.R.C.P., M.P.C.S.—Dr. Poore, Emeritus Professor of Medicine and Clinical Medicine at University College, London, and consulting physician to the hospital, died at his house at Andover on Wednesday, 23rd November, after a long illness. He was a member of the Society of Arts, and in January, 1885, he delivered a course of three Cantor Lectures on "Climate, and its Relation to Health." Dr. Poore, the son of Commander John Poore, R.N., was born at Andover on 23rd September, 1843; he was educated at the Royal Naval School, New Cross, and University College, London, and at the hospital he was a favourite pupil of Sir William Jenner. He became a member of the Royal College of Surgeons in 1866, in which year he was surgeon to the Great Eastern Steamship during the laying of the Atlantic cable. He was member of the Royal College of Physicians in 1870, and a Fellow in 1877. He was medical attendant to the late Prince Leopold, Duke of Albany, 1870-71, and assistant physician to University College Hospital, becoming full physician in 1876. He was widely known as an authority on sanitary subjects, and was General Secretary of the International Congress of Hygiene and Demography, 1891. His strenuous condemnation of all systems of sewerage which carried away from the soil matters capable of enriching it was expressed in various books, pamphlets and addresses, and the principles which guided him were practically illustrated on his property at Andover. He succeeded Professor Erichsen as inspector under the Vivisection Acts, and published several works and papers on strictly professional subjects, one of these being a Treatise on Medical Jurisprudence.

GENERAL NOTES.

PERSIA AND COTTON CULTIVATION.—Referring to an article that appeared in the last number of the *Journal* upon the world's cotton supply, the following remarks taken from Mr Consul-General Preece's report on trade in Persia (just issued) may be read with interest. The Consul-General writes:—Owing to the advent of Russian buyers the amount of cotton floated in Ispahan and its environs has of late years steadily increased in spite of the fact that the cotton, owing to the poverty of the ground and want of renewal of seed, has equally steadily deteriorated. In days gone by Ispahan cotton had a very high place in the estimation of the people of the East, but that is quite lost. The staple now is short and brittle, all the same it has a ready sale for export to Russia, and also to a smaller extent to Bombay, where it is mixed with Indian cotton for use in the home market. The amount exported last year to Russia was 5,000,000 lbs., and to Bombay over 400,000 lbs. Since the war broke out in the Far East there have been practically no purchases for Russia, yet this year's crop is heavier than that of the previous one. The staple of Ispahan cotton is too short for Lancashire requirements even supposing that the cotton could be cultivated in sufficient quantities to make it worth while to import it, but this would not prove remunerative enough until easier and cheaper means of communication were found. In the valley of the Karum if only proper irrigation works are undertaken, good cotton could be cultivated for the home market to a very large extent.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

DECEMBER 7.—"The International Exhibition at St. Louis." By WALTER FRANCIS REID, F.I.C., F.C.S. DR. BOVERTON REDWOOD, F.R.S.E., will preside.

DECEMBER 14.—"The Patent Laws." By CHAS. D. ABEL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 8.—"Burma." By SIR FREDERIC FRYER, K.C.S.I. In consequence of the lamented death of the Earl of Hardwicke, announced to preside, SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., Member of the Council of India, has kindly consented to take the chair.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

DECEMBER 20 (8 p.m.).—"Street Architecture." By THOMAS GRAHAM JACKSON, R.A. DR. G. B. LONGSTAFF, L.C.C., will preside.

Papers for Meetings after Christmas:—

"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By The RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY.

"London Electric Railways." By the HON. ROBERT P. PORTER.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTAN.

"The True Musical Pitch of Notes we See and Sounds we Hear." By JOHN E. BORLAND.

"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES.

"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN.

"Popular Jewelry." By MONSIEUR LALIQUE (Paris). (*Applied Art Section.*)

"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. (*Colonial Section.*)

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with musical illustrations).

LECTURE II.—DECEMBER 5.—*Brass Instruments.* —Primitive instruments from horns and shells—Harmonic scale—Development into bugle and trumpet types—natural horns and trumpets—Introduction of slides, keys, and valves.

JUVENILE LECTURES.

Two lectures suitable for a juvenile audience will be delivered on Wednesday evenings, January 4 and 11, 1905, at Five o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. David James Blaikley, "Musical Wind Instruments." (Lecture II.—Brass Instruments.)

Farmers' Club, 2 Whitehall-court, S.W., 4 p.m. Mr. Thomas F. Plowman, "The Policy of the Show-yard and its Administrative Methods."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. William Edward Storey, "Condensing Machinery."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. E. Divers (*a*) "Raschig's Theory of the Lead Chamber Process;" (*b*) "Theory of the Action of Metals on Nitric Acid." 2. Mr. Llewellyn J. Davies, "A Rapid and Accurate Method for the Estimation of Phosphorus in Iron Ores." 3. Mr. C. S. Stanford Webster, "Fluorescope for Comparing Substances under the Influence of Radium Rays."

British Architects, 9, Conduit-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Victoria Institute, 8 Adelphi-terrace, W.C., 4½ p.m. Rev. F. Storrs Turner, "The Right Way in Psychology."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Arthur Diósy, "The probable results of the Russo-Japanese Conflict as affecting Commerce in the Far East."

TUESDAY, DEC. 6...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. John Francis Cleverton Snell's paper, "Distribution of Electrical Energy." 2. Messrs. Arthur Wood-Hill and Edward Davy Pain, "The Construction of a Concrete Railway Viaduct."

Pathological, 20, Hanover-square, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall-rooms, Whitehall-place, S.W., 8 p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, DEC. 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Walter Francis Reid, "The International Exhibition at St. Louis, U.S.A."

Geological, Burlington-house, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Mr. J. Moore, "Horses of different Countries and Supply, with relation to Military Services."

Entomological, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. 1. Mr. J. Hilton, "The Pfahlgraben and Saalburg, in Germany." 2. Mr. Philip H. Johnston, "Mural Paintings recently Discovered in Trotton Church, Sussex, &c."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

THURSDAY, DEC. 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir Frederic W. R. Fryer, "Burma."

Royal, Burlington-house, Piccadilly, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. The Hon. Charles S. Rolls, "The Development of Motor Traffic."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. H. E. Bellamy "Notes on Portland Cement."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on papers by Prof. H. S. Hele-Shaw, Dr. A. Hay, and Mr. F. H. Powell, "Hydrodynamical and Electromagnetic Investigations regarding the Magnetic-Flux Distribution in Toothed Core Armatures." 2. Mr. G. F. C. Searle, "Studies in Magnetic Testing."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, DEC. 9...Astronomical, Burlington-house, W., 8 p.m.

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Mr. T. Raffles Davison, "Some Architectural Reflections."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, in the Physical Laboratory of the Central Technical College, Exhibition-road, S.W., 8 p.m. 1. Prof. S. P. Thompson, "A Rapid Method of Approximate Harmonic Analysis." 2. Mr. W. Duddell, "A High-Frequency Alternator." 3. Exhibition of Experiments to show the retardation of the signalling current on 3,500 miles of the Pacific Cable between Vancouver and Fanning Island. 4. Exhibit of Ayrton-Mather Galvanometers, Universal Shunts, and Electrostatic Instruments."

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FRIDAY, DECEMBER 9, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 12, 8 p.m. (Cantor Lecture.) D. J. BLAIKLEY, "Musical Wind Instruments." (Lecture III. Reed instruments, with musical illustrations.)

WEDNESDAY, DECEMBER 14, 8 p.m. (Ordinary Meeting.) CHARLES D. ABEL, "The Patent Laws."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 4th and 11th, at 5 o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

INDIAN SECTION COMMITTEE.

A meeting of the committee of the Indian Section was held on Thursday afternoon, 1st inst. Present:—Sir William Lee-Warner, K.C.S.I. (in the chair), J. A. Baines, C.S.I., Sir Stewart C. Bayley, K.C.S.I., T. J. Bennett, C.I.E., Dr. H. M. Birdwood, C.S.I., Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., F. C. Danvers, J. F. Finlay, C.S.I., Colonel Sir Thomas Holdich, R.E., K.C.M.G., C.B., Alexander Rogers, Sir Edward Sassoon, Bart., M.P., Carmichael Thomas, W. Martin Wood, with Sir Henry Trueman Wood, Secretary of the Society, and S. Digby, Secretary of the Section. The arrangements for the session were considered.

CANTOR LECTURES.

Mr. D. J. BLAIKLEY delivered the second lecture of his course on "Musical Wind Instruments," on Monday evening, 5th inst.

The lectures will be printed in the *Journal* during the Christmas recess.

INDIAN SECTION.

Thursday afternoon, December 8th. Sir CHARLES H. T. CROSTHWAITE, K.C.S.I., Member of Council for India, in the chair.

The paper read was "Burma," by Sir FREDERIC FRYER, K.C.S.I.

The paper and report of the discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 7, 1904; DR. BOVERTON REDWOOD, F.R.S.E., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Dale, Hylton William, 8, Chalcot-gardens, Belsize-park, N.W.

Ertz, Edward Frederick, R.B.A., Polperro, Cornwall.

Fletcher-Watson, P., R.B.A., Ashleigh, Paignton, South Devon.

Lee, Sydney, 6, The Studios, Holland-park-road, Kensington, W.

Lim Chin Tsong, 47, China-street, Rangoon, Burma.

Stell, Samuel Fenton, F.C.S., 25, Henry-street, Keighley, Yorkshire.

Townend, Frederick Bedborough, 11, Queen Victoria-street, E.C., and Brentwood, Essex.

The following candidates were balloted for and duly elected members of the Society:—

Heraje, Pandoorung, Agar Bazar, Dadar, Bombay, India.

Hnyin, Tha, B.A., F.C.S., 13, Ladbroke-road, W.

Ince, Robert Self, 24, Deerbrook-road, Herne-hill, S.E.

Jagonnath, Ganpat, Lady Jumshedjee-road, Dadar, Bombay, India.

Jordan, Albert Edward, A.M.I.Mech.E., 6, High-road, Nungumbaukum, Madras, India.

Moorcroft, Harold, Marsh-parade, Wolstanton, Staffs.

Townsend, W. G. Paulson, 12, Clifford's-inn, Fleet-street, E.C.

Wheatley, William Humphrey, 40, Chancery-lane, W.C.

The CHAIRMAN said:—To many of you the reader of the paper is already known personally, to many more by repute, but even Mr. Reid's best friends are probably unaware of the extent and important character of the work which he has recently carried out as juror at St. Louis under trying climatic conditions. Mr. Reid went to St. Louis as one of the two representatives of Great Britain nominated by the Royal Commission to serve on the International Jury for Chemical and Pharmaceutical Arts, his colleague being Mr. H. J. Helm. In the first instance the author and Mr. Helm were members of the Group Jury dealing with Chemical and Pharmaceutical Arts, and Mr. Reid has borne testimony to the great assistance given and excellent work accomplished by his colleague. Mr. Reid was then successively appointed vice-chairman for Group 23, for Group 22, for Liberal Arts, for Horticulture, and for Aeronautics; also member of the Superior Jury and Secretary of the Appeal Committee for Horticulture, Agriculture, and Physical Culture. I have always recognised in Mr. Reid the possession of encyclopædic knowledge, but I am really surprised that with these multifarious demands upon his energies, in a climate which was at the time subtropical, he returned to this country in mental and physical soundness, especially when we remember that our American cousins are not lacking in hospitality, so that I have no doubt he was often called upon to serve on a gastronomic jury at the close of the day's work. To all but those familiar with exhibition jury work these duties, though manifold, may appear simple if the executant is possessed of the necessary knowledge of the products with which he and his colleagues have to deal, but, in effect, there is no work demanding in addition greater discretion, judgment, and general diplomatic ability. Theoretically, the duty of a jury is to form a judgment of the respective and relative merits of the exhibits, and to recommend awards accordingly, but there are many other matters, such as the importance and originality of the processes by which the products have been obtained, and the difficulties which have had to be overcome in achieving commercial success, which have to be taken into account. Finally, in the case of an international jury there are the inevitable national rivalries and jealousies to be dealt with, and it is then that diplomatic ability becomes an essential factor. At this stage each member of the jury necessarily becomes largely an advocate, at any rate in the sense that it devolves upon him to see that his foreign colleagues fully appreciate the special merits of the exhibits contributed by the country which he represents. In discharging these delicate duties Mr. Reid's exceptional linguistic abilities proved most valuable, indeed, so essential that he was called upon to fill the honorary office of interpreter in general, which certainly did not fall within the scope of the work of a juryman. However good may be our British exhibits, the numerous contributors would certainly not have obtained for them the high awards of which a list has been published if Mr. Reid had not discharged with conspicuous ability the varied, difficult, and highly responsible duties to which I have alluded.

The paper read was—

THE INTERNATIONAL EXHIBITION AT ST. LOUIS, U.S.A.

BY WALTER FRANCIS REID, F.I.C., F.C.S.

When the Society of Arts, in 1851, initiated the first great international exhibition, few can have anticipated that the movement would have been accepted by all civilised nations so rapidly as has been the case. In 1850, H.R.H. The Prince Albert said:—

"Nobody who has paid any attention to the particular features of our present era will doubt for a moment that we are living at a period of most wonderful transition, which tends rapidly to the accomplishment of that great end to which, indeed, all history points—the realisation of the unity of mankind."

Those remarks are even more applicable now than they were half a century ago, and there are indications that the seed sown by our late illustrious and far-seeing President is producing fruit. It is not a casual coincidence that the year of the great St. Louis Exhibition should witness the signature of treaties of arbitration between most civilised nations, and that disputes which, but a few years ago, would have meant war with all its horrors and irreparable losses to both victor and vanquished, should now be settled calmly and peacably.

As one of the 20,000,000 visitors who passed through the gates that were closed last Thursday, I will endeavour to give you a brief account of the buildings and their contents. The general aspects of the St. Louis Exhibition have been so fully dealt with in the paper read

before this Society in November, 1903, by Mr. G. F. Parker, that my introductory remarks may be brief. As most of you are aware, the "Louisiana Purchase Exposition" was held to commemorate the centenary of the purchase in 1803 by the United States from France of the territory of Louisiana. The city of St. Louis was chosen as the site, and those who have lived among its 600,000 courteous and hospitable inhabitants will admit that the selection was a wise one. An area of 1,240 acres about six miles from the Mississippi front of the city was set apart for, but not completely occupied by, the exhibition buildings. It is a great mistake to devote too large an area to an exhibition. Most of the visitors have but a short time to stay, and it is extremely disappointing to them to be obliged to waste valuable time in traversing considerable distances between the buildings. The means of communication between the buildings were very defective, for although there was an intramural electric railway, about eight miles in length, it did not serve many of the chief buildings, and was interrupted at the most important spot. One of the chief lessons to be learnt from St. Louis, is that there are limits to the dimensions of an exhibition beyond which it is not advisable to go. None but a trained pedestrian could hope to see the whole of the exhibition within a reasonable time. Let us hope that the next "World's Fair" may be concentrated within a more reasonable area.

But there are other, and more important, lessons that may be learnt from this great concourse of nations. Probably the most useful feature was the great number of international congresses held at St. Louis. These numbered about 300, and there can have been few departments of human work or thought that were not represented from all parts of the globe. Innumerable friendships have been made among the members of these congresses and of the various juries, and the amicable relations thus established cannot fail to have a favourable influence upon the intercourse of the nations whom they represented.

You will probably wish to know whether there may not be some special lessons which Great Britain has to learn from the nations with whom she has been engaged in friendly rivalry. I think there are, especially from one point of view, which is of great importance if we are to maintain our proper industrial and commercial position. Mr. F. J. V. Skiff, the director of exhibits at St. Louis, and who also gained great experience at Chicago, rightly says:—"The creation of expositions has become a profession." Our chief competitors for the world's commerce have long since realised that in the contests of peace even more than in war it is necessary to be prepared beforehand, and they have organised permanent departments for exhibition work, thus securing continuity of experience and ideas. We alone, the originators of international exhibitions, are content to leave these matters to chance, and when an exhibition is announced, we tardily collect the best men we can find, among whom are fortunately some who have had previous exhibition experience. It is true that we have done well at St. Louis, but this is due to the zeal and ability of those who represent us rather than to a system which leaves so much to be done at the last moment. A careful observer could not fail to notice many points in the organisation of other nations that we should do well to copy, but we have no machinery for doing so. The Society of Arts was formerly the body that kept up the continuity of ideas between the various exhibitions, but these undertakings are now so vast as to be beyond the powers of any single society. I see no reason, however, why a joint committee of this and other societies should not be formed to collect the experience gained at St. Louis, and to utilise it as soon as another international exhibition is projected.

The construction of the buildings in a great exhibition and the arrangement of the exhibits in them are matters of primary importance, and must to a great extent depend upon the funds available. The financial balance-sheet of the St. Louis Exhibition has not yet been published, but it is known that about £4,000,000 was spent in the first instance. It will suffice for the present if I give you the approximate cost of the chief buildings as we pass them under review. If the enterprise has not been a financial success for its promoters it has undoubtedly benefited the country, and from that point of view the money has been well spent. Of course the benefit to the town of St. Louis must have been very considerable. In the building of the exhibition much skill and ability have been shown. The great majority of the structures consist of a wood framework built approximately to the shape required. Upon the wood, expanded steel sheets are nailed, and the surface is finished off with plaster. The plaster adheres well to the expanded metal, into the interstices

of which it penetrates. In wet weather, however, considerable masses of plaster fell from the horticultural and agricultural buildings. Perhaps the incessant cannonade from the representations of the Boer War and the Battle of Santiago contributed towards this premature disintegration of the buildings.

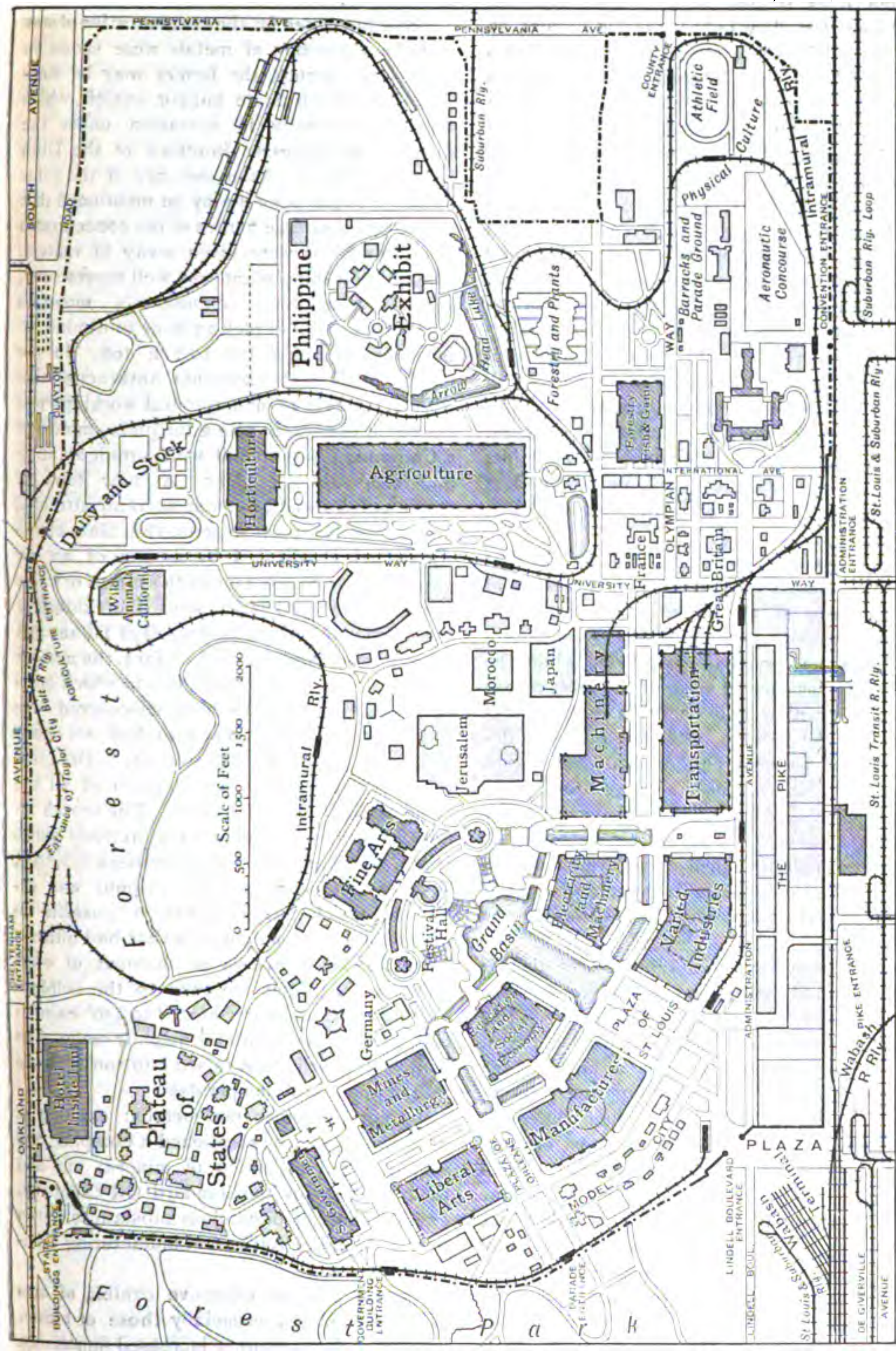
Such structures are necessarily highly inflammable, and stringent precautions had to be taken against the introduction of naked lights into the buildings. Even flash-lights for photographic purposes were forbidden. It is probably owing to the excellent arrangements made in this respect that serious conflagrations have been avoided.

In the time at our disposal we can only examine about a dozen of these buildings and but very few of the thousands of exhibits. As regards the latter, I have endeavoured to select those which are of general interest or which have some special reference to Great Britain.

We will begin with the *United States Government Building*. This occupies one of the best situations on the whole site, on sloping ground facing the Liberal Arts and Mines and Metallurgy palaces. It contains the chief exhibits of the United States Government, and its cost was estimated at about £26,000. It is about 925 feet long and 250 feet broad, covering an area of 9·1 acres. The building contains the fullest collection of Government exhibits that has ever been shown. Especially noteworthy are the exhibits of the army, with a complete set of cartridge-making machinery in operation; the post-office, including a complete set of United States stamps and a good series of models showing the methods of carrying mails, from the Esquimaux dog sledges of Alaska to the pneumatic postal tube so extensively used in New York and other large cities. The navy is represented by a full-size model of a war-ship and a tank containing stationary mines. One of the most attractive displays is that of the Smithsonian Institution, containing a large and well-selected collection of natural history, specimens ranging from gigantic meteorites to restorations of some of the colossal saurians recently discovered by American paleontologists. The Bureaux of Animal and Plant Industry and the Department of Entomology have also interesting exhibits illustrative of the work carried on under their auspices. The tax-payer of the United States who visits this building can form a very good idea of the way in which much of the public money is spent and the object-lesson is one that might with advantage be repeated in this country.

Facing the east end of the United States Government Building is the *Palace of Liberal Arts*, which is 750 feet long, and 525 feet wide, covering an area of about 9 acres. Its cost was £95,000. Exhibits comprised in groups 15 to 27 were mainly contained in this building; but, except in the case of Great Britain, this classification was not rigidly adhered to, with the result that much time was wasted by the juries in going from one building to another. The arrangement of exhibits is always a difficulty; but for the visitor who wishes to study any special subject it is undoubtedly better to have objects of the same kind under one roof. This may, however, in many cases render the supervision of the exhibits by the agents of the various countries or exhibitors less efficient. It is difficult to estimate in advance how much space may be required in each building, and it may sometimes be advisable to devote surplus space originally assigned to one group to the relief of another that may be over-crowded. Although Great Britain did not rank first as regards the number of exhibits in this building, yet the quality, as indicated by the number and nature of the awards, was excellent. The preparatory work done by our Royal Commission and the full particulars which had been obtained from the exhibitors for the use of the jury ensured a full appreciation of the merits of each exhibit.

First, both as regards the number of exhibitors and of awards, comes Group 23, Chemical and Pharmaceutical Arts. The sub-committee for this group, under the chairmanship of Dr. Boverton Redwood, our chairman this evening, had secured so high a standard of excellence in the exhibits that 112 exhibitors obtained 100 prizes. Most of our large chemical and pharmaceutical manufacturers were well represented, and the most careful comparison with other nations failed to show any trace of that decadence in our chemical industry that is the favourite stalking-horse of some educational enthusiasts. After an exhaustive examination of all the chemical exhibits Dr. E. H. Keiser, the distinguished professor of chemistry at Washington University, adopted the descriptive catalogue prepared by our Royal Commission as an advanced text-book of technical chemistry, and brought his students to the British exhibits as up-to-date samples of chemical products. It is doubtless true that other



GROUND PLAN OF THE ST. LOUIS EXHIBITION, 1904.

nations surpass us in certain articles such as aniline dyes or synthetic drugs; but the tendency of modern industry is for nations as well as individuals to specialise, and it by no means follows that, because other countries may be doing a remunerative business in articles that we once produced, we have lost the business. Our capitalists and workers may have found even more remunerative outlets for their abilities, and it is only where they are hampered by unfair fiscal restrictions and patent laws that redress is needed. Germany had an excellent chemical exhibit, both of products and apparatus, which was housed in the Palace of Electricity, and included a large collective exhibit of the goods of numerous chemical manufacturers. France showed a fine selection of pharmaceutical preparations and perfumery arranged in artistic show-cases. The United States included among her exhibits the finest collection of chemicals exhibited at St. Louis by one firm—the Mallinckrodt Chemical Works.

The Chinese Government had, for the first time, an official collection of materials and drugs, many of the latter unknown to the Western world. In photography Great Britain exhibited an excellent collection, while the United States showed some of the most recent forms of printing machinery in daily operation. In the Liberal Arts Building were delivered the lectures on liquid air and liquid hydrogen which had been arranged for by our Royal Commission, and which attracted numerous audiences. The machinery by which hydrogen could be liquefied and even solidified was installed in a special building and aroused much interest among scientific visitors to the exhibition.

Immediately facing the Liberal Arts Palace and separated from it by a sunken garden was the *Palace of Mines and Metallurgy*. The building has a floor area of about 9 acres, but the department includes a further area of 12 acres occupied by separate mining exhibits in the mining gulch. The architecture of this building is probably the most original of any in the exhibition, and the cost has been given as £99,600. Its contents show the boundless mineral wealth of the United States, and the system of having separate sections for each State has produced a healthy rivalry calculated to show off those resources to the best advantage. Among the British exhibits, an interesting collection of minerals and stones by the mining department of the Home Office attracted much attention, and the Iron and Steel Institute showed a valuable collection of literature.

Many processes for the concentration of ores and the extraction of metals were shown in operation. Among the former may be mentioned the Utah State mining exhibit, which was shown daily in operation under the direction of Professor Bradford of the Utah School of Mines. As an instance of the value attached to publicity it may be mentioned that 20,000 small sample bottles of the concentrates from this plant were given away to visitors. The rock-crushing plant was well represented, varying from huge omnivorous monsters crushing 500 tons of rock an hour to diminutive machines crushing but half a ton. In the mining gulch a Pennsylvania anthracite mine with 1,750 feet of underground workings was shown in operation, also a turquoise mine and a Californian stamp mill with amalgamating and concentrating plant. A new form of stamp mill worked by compressed air attracted much attention from experts, the blow of the stamp being adjusted by means of an air cushion so as to avoid injury to stamps or frame should the material vary in size. The exhibits of gems and polished opalised wood of Tiffany and Co. were generally admired, in fact, the number of localities in the United States in which gems of various kinds have been discovered was quite a revelation to those who had not made a special study of the subject. Of great scientific interest was a collection of all the radio-active minerals known. The search for new sources of radium is being actively prosecuted, and many new finds have been reported. A new method of mining sulphur was exhibited, which has rendered it possible to utilise the Louisiana deposits that had hitherto been difficult of access on account of overlying sands. Pipes are sunk to the sulphur-bearing rock, and water heated to 330° Fahrenheit is forced down until the sulphur melts. The molten sulphur is then raised into tanks at the rate of about 500 tons per day.

Among the other non-metallic exhibits of importance, may be mentioned a complete and well-arranged collection of mineral oils and their products by the Standard Oil Company, and a number of bituminous substances shown by the Trinidad Asphalt Manufacturing Company.

Canada had an extensive exhibit of ores of various kinds, especially those of nickel, which metal is acquiring increased importance from its use for naval and military purposes.

The Bethlehem Steel Company showed a

large quantity of war material, including a full-size model of a 12-inch gun and turret, together with a selection of armour-plates and guns of various dimensions.

Under the supervision of the chief of the Department of Mines and Metallurgy, Dr. J. A. Holmes, one of the most complete series of coal tests that have ever been undertaken is being carried out. Congress has voted a sum of £12,000 to defray the cost of the work; but the apparatus and coal are furnished by the owners free of cost. Each test is made with a car load of coal, which is loaded at the mine under the supervision of an official who takes the samples required for chemical analysis from the face of the seam. The experiments include producing steam, generating gas, coking in coke ovens, briquetting and washing. Careful chemical and practical tests are made not only of the coal itself but also of the various products obtained. The results of so complete a series of investigations will be of great use not only to the United States but to coal users throughout the world. A description of this department would not be complete without a reference to the colossal iron statue of Vulcan, representing the iron industry of Alabama. The height of the statue is 50 feet and the weight about 67 tons.

The next building is that of *Education and Social Economy*, which also covers an area of about nine acres. It is estimated to have cost about £63,879. Although so large a building has been set apart for educational purposes it must not be forgotten that the whole exhibition is an educational exhibit of the highest order. No one could visit it even for an hour without acquiring some useful information or seeing something he had never seen before. In these days of rapid progress the education of the adult is of even more importance than that of the child, and there is no easier way of acquiring information than a visit to a great exhibition. It is to be feared that many of those occupying responsible positions in this country do not devote much of their leisure time to keeping their knowledge up-to-date. Those who visit exhibitions frequently, must have noticed many cases in which old-established firms are hopelessly behind the times in technical knowledge.

The British educational exhibit is quite up to date and probably affords the best object-lesson that has ever been brought together of the variety of educational facilities available in this country. Not only has the Education Committee of the Royal Commission been very successful in obtaining a good collection of exhibits from all the British universities and other educational institutions, but the best possible use has been made of that collection by Capt. P. H. Atkin, the energetic and courteous representative of that Committee in St. Louis. It is true that our exhibit does not contain such large collections of apparatus as are to be found in the German section; but it should be borne in mind that the greater part of this apparatus is not new, and the quantity transported to and set up at St. Louis is chiefly a question of the funds available for that purpose. The German educational exhibit is, however, as might have been expected, of high character, and the hand-books issued on educational and social subjects are interesting reading.

The United States are well represented, a grant of £20,000 having been voted by Congress for exhibits of the mechanical and agricultural experiment stations and colleges. There can be no doubt that the agricultural experiment stations have had a most beneficial and far-reaching effect upon the agriculture of the country, and have added greatly to its prosperity.

The *Palace of Manufactures* and the *Palace of Varied Industries* contain exhibits so closely allied that they may well be taken together. Each building is 1,200 feet long and 525 feet broad, encloses 14 acres, and cost about £130,000. No doubt, chiefly for fiscal reasons, British manufacturers were not so strongly represented as might have been the case in a country with a lower import tariff. Among those industries that had good exhibits may be mentioned decorative and fixed furniture, ceramics, and lace and embroidery. The Italian sculpture attracted much attention, and the French costume and millinery displays were generally surrounded by an admiring crowd. Japanese industry was well represented, especially in silks, ceramics, and art metal work. When war was declared between Russia and Japan, the former country abandoned the idea of taking part in the exhibition, and relinquished the space reserved for her. Japan at once took it up, and has not only filled it but filled it well. To those who have watched the development of Japanese industry it must be evident that the tendency to imitate European goods is increasing very rapidly; sometimes the imitation includes the label or trade mark.

Among the numerous industries shown in operation the rearing of silkworms and production of silk were very popular. The well-known

St. Louis firm of Mermod and Jaccard showed in active operation all the processes of enamelling as applied to jewellery, and Messrs. Krupp exhibited a new process for the embossing of gold and silver ware. In this new industry a powerful hydraulic press weighing 120 tons is used. The design is engraved on the inside of a hollow steel die made in four pieces, and into this die the plain silver vessel is placed. Inside the silver vessel an india-rubber lining is inserted, and the air between the two materials exhausted. The whole is then placed in the cylinder of the hydraulic press, and a pressure of about 85,000 lbs. per square inch applied. Under this enormous pressure the silver becomes plastic, and gives a beautiful reproduction of the most minute details of the die.

Many other industries were represented in actual operation, especially the manufacture of leather, boots, hats, textiles, &c. Forty nations sent exhibits representing 900 industries, and it would require at least a week to give a description of the contents of these two buildings. Before leaving the palace of varied industries we will pass through some of a large number of rooms in the German section which present many features of interest. Each room, together with its furniture, has been designed by one architect, thus securing uniformity of design. Dr. Lewald, Imperial Commissioner-General for Germany, has been kind enough to send me some special photographs of these rooms which will no doubt interest you.

The Palace of Electricity covers about 9 acres and its cost is stated to have been £80,000. There can be no doubt that the United States occupy the first position as regards general electrical appliances, but Great Britain has the best collection of testing, measuring, and recording instruments, and her exhibitors obtained awards worthy of the country of Faraday and Kelvin. One of the most noticeable features of the St. Louis Exhibition was the extensive use of electricity for a variety of purposes. It was the chief means for the transmission of power and practically the whole place was lighted by electricity. About 500,000 incandescent lamps were used for the illumination of the grounds and buildings. In metallurgy electricity has supplied us with the means of obtaining results that were formerly beyond our reach, and for many industrial and even domestic purposes it has become indispensable. Progress was specially marked in motors for street railways, and an experimental track was provided for carrying out practical tests with electric cars. One of the biggest searchlights ever constructed was in operation; it weighed four tons, and its light was estimated at 5,250,000 candle-power. Several systems of wireless telegraphy were exhibited and worked, and a wireless telephone was in use over short distances. The extent of the illumination of the grounds and buildings exceeded all previous displays, and the effect was magnificent. In many cases the lights themselves were hidden behind columns and the façades of the buildings were lit up by a soft, reflected light which was extremely effective. The direct illumination of the cascades by means of powerful searchlights from adjoining buildings was not so successful as incandescent lamps placed behind the falling water.

In connection with light the exhibit of the Finsen light must not be forgotten. Much electro-therapeutic apparatus was shown as well as the most recent forms of X-ray tubes for diagnostic purposes.

An interesting historical collection of electric appliances was sent by F. A. Edison, whose new storage battery attracted many visitors.

So intimately connected are power and electricity in modern practice that to study the production of the latter we must pass out to the *Palace of Machinery*, the dimensions of which were 1,000 feet by 525 feet, while the cost was £93,391.

Considering that a force of 50,000 horse-power was being generated in this building, the absence of noise was perhaps the most striking feature. Although much of the machinery rotated with great rapidity, it did so quietly, while at the same time it conveyed to the observer a sensation of concentrated energy difficult to define. An ordinary steam fire-engine in our streets makes more noise than these motors that were pumping 90,000 gallons per minute to a height of 100 feet. The general impression derived from the exhibits in this building is that for the production of electricity on the large scale steam turbines are rapidly supplanting reciprocating engines. The use of producer gas may give a fresh lease of life to the latter; but even here the turbine principle may ultimately be adapted. The lubrication difficulties appear to have been surmounted in the case of the steam turbine. The Curtis steam turbine, for instance, weighing 70 tons, and generating 2,000 horse-power, can be easily moved by the hand, and if the steam be cut off while the

turbine is working at 1,500 revolutions per minute, it will continue to revolve for three hours. The moving parts are practically supported upon a film of oil at a pressure of 600 lb. per square inch. Large as they are, the steam turbine generators exhibited were small compared with others under construction elsewhere. The small space required by steam turbines may be judged from the fact that a 600 horse-power Westinghouse-Parsons turbine measures 18 feet 6 inches in length, 4 feet 6 inches in width, and 7 feet 6 inches in height.

This building also contained a fine collection of machine tools of various kinds, varying in size from a 170-ton boring and turning machine down to delicate watch-making plant, working with an accuracy of one ten-thousandth part of an inch.

A veneer-cutting machine which converted logs of wood into gigantic shavings of the required thickness attracted many of the visitors. The supply of steam for the machinery building passed through a tunnel of 56 square feet section from the *Steam, Gas, and Fuel Building*, also called the *Power House*. This was a comparatively small building, being 320 feet by 320 feet, and differed from the majority of the buildings in being of fireproof construction. The daily fuel consumption was over 400 tons, the coal being brought direct from the mines in 170 fifty-ton coal cars. The coal was bituminous and at times dense clouds of smoke were produced, obscuring the adjoining buildings. Nearly the whole of the stoking was mechanical; from the time the coal was tipped from the waggons until the clinkers and ashes were removed in trucks no handling was required. All the boilers were of the water-tube type, of which several varieties were at work. A battery of 16 Babcock and Wilcox boilers supplied 6,400 horse-power, while the same number of Aultman and Taylor boilers of two different sizes produced steam equal to 7,200 horse-power. With regard to the competition between steam and gas-engines as sources of power, it should be mentioned that, owing to questions of insurance the latter were not so well represented as their importance would have justified.

Facing the Power House is the *Transportation Palace*, which is the largest of this group of buildings, being 1,300 feet long, and 525 feet wide; the cost was £139,200. Owing to the size of each exhibit the number of entries was not large; but the building contained many novelties of importance. Perhaps the most up-to-date exhibit was a model of the new 25-knot turbine steamer now under construction for the Cunard Steamship Company, Limited. The same company exhibited a most important historical series of models constructed to the same scale, commencing with the 440 horse-power 8½-knot *Britannia* of 1840, and finishing with the turbine steamship just referred to, of 75,000 horse-power.

The railways of the United States were well represented both as regards cars and engines. A complete train of Pullman cars, containing the most recent improvements, was a very popular attraction. So complete and substantial are these cars at the present time that the weight amounts to about 2 tons per passenger. The Baltimore and Ohio Railway Company showed a unique historical collection of locomotives from the earliest types down to the latest Mallet articulated compound locomotive with 4 cylinders and 12 driving wheels. A very striking object-lesson was a powerful locomotive of the American Locomotive Company, mounted upon a high turntable, 70 feet in diameter, and rotating by means of an electric motor. The weight of engine and tender was 145 tons. Another exhibit that attracted much notice was the high-speed engine of Messrs. Henschel and Son, of Cassel, designed to draw a train of 200 tons at a speed of 80 miles an hour. Its weight, including tender, was 136 tons, and in several particulars its construction differed from the usual practice. To diminish the air resistance the upper part of the engine is encased in steel plates and the front is wedge-shaped. It has run 85 miles per hour with three cars and developed 1,775 horse-power with a coal consumption of 2½ lb. per horse-power. A full-sized model of the Pennsylvania Railroad Company's tunnel under the Hudson River at New York which is now approaching completion showed some special features. The ground being treacherous, stability for the tunnel was secured by driving massive iron piles through the floor of the tube and uniting their heads by means of girders. The English engineer, Mr. C. M. Jacobs, M.I.C.E., has embodied some other features of interest in the construction. The same railway company carried out a careful series of tests on 20 locomotives in this building, 25 men being employed continuously. Numerous safety appliances for railways were exhibited; inventors evidently hope that American railway companies may some day feel ashamed of slaughtering 12,000 human beings

annually on their lines and adopt some of the precautions that have proved successful in other countries.

To the department of transportation belongs the *Aeronautical Section*, of which great things were expected. The management of the exhibition incurred considerable expenditure and devoted a large area to the appliances necessary for aeronautical competitions. Very large money prizes were offered, and although the conditions of the contests were somewhat severe, yet, as Mr. Willard A. Smith, the chief of this department, rightly says, the aim was to induce aeronauts to produce something superior to that which is already known, not merely to institute a competition between well-known appliances.

The authorities of the exhibition are to be congratulated upon the courageous effort which they have made to advance the one form of locomotion in which man lags behind some of the humblest of his fellow-creatures. Although no aeroplane entered the lists, yet the kite competitions, and gliding experiments afforded some valuable information, and there can be little doubt in the minds of those who have studied the subject carefully in the light of modern improvements that most of the elements necessary for mechanical flight already exist. It is remarkable that none of our philanthropic millionaires have contributed towards the solution of a problem which would confer such lasting benefits on mankind.

The next building, which we will consider, is that devoted to *Forestry, Fish, and Game*, which is one of the smaller structures, although 600 feet long and 300 feet broad. What impresses the visitor most is the enormous variety of timber—lumber, as it is called here—which has been brought together from all parts of the globe, but especially from the United States. The exhibition buildings themselves form the best object lesson of the use of yellow pine, of which they contain four hundred million feet. Numerous objects made from wood were shown, together with a very varied collection of forest products of all nations. Some of the groups of game and fur-bearing animals and of birds were very artistically mounted in their natural surroundings. In another part of the grounds the Department of Fisheries of the United States had a special building devoted to fish and fish products. Here fish hatcheries were shown in operation, and the various edible fishes of the United States displayed alive in capacious tanks.

We now come to the *Agricultural Building*, the largest of all, being 1,600 feet long and 500 feet. broad. The floor space is about 20 acres, and to inspect all the exhibits a walk of about nine miles would be necessary. The whole of our 1851 exhibition could be placed inside this building. The cost of construction was £106,000. It will be evident that the time at my disposal is quite insufficient to give even a superficial idea of the contents of this enormous building. A large working exhibit, of British origin, of confectioners' and bakers' machinery was very popular, but on the whole the building chiefly contained products from the United States. Nearly every State had an exhibit, and there was much rivalry in displaying the various products to the best advantage. The State experiment stations showed their results in concise and attractive form, and distributed instructive literature free of cost to all those interested. Some of the agricultural trophies were well designed, and would have had an excellent effect had they not been dwarfed by the gigantic building in which they were placed. The Canadian trophy showed that the Dominion is far advanced in the production of grain of various kinds, and its collection of honey was the best exhibited. This building undoubtedly contained the finest collection of agricultural produce ever brought together, and was well calculated to convey a favourable impression of the enormous agricultural resources of the United States. After wandering for miles through lanes of wheat, maize, tobacco, cotton, sugar-cane, &c., one could not fail to realise that agriculture is still the chief industry of the country. Labour-saving appliances were numerous, windmills and automobiles especially being adapted to a variety of purposes. An eight-share automobile plough by means of which two men can plough 40 acres daily would probably find few purchasers in Great Britain; but the first one sold went to Johannesburg. It was curious in travelling through the country to see some of these most recent implements at work on farms alongside the old-fashioned snake-fence, so wasteful of land and timber. Dairy products were well represented, one striking exhibit being a number of life-size groups modelled in butter and arranged in a refrigerator with plate-glass sides. The creameries in the United States have got over the difficulty of milk dilution by buying their milk according to its percentage of butter fat which is estimated in a very simple manner.

The Horticulture Building is of more moderate dimensions, covering only six acres.

In it the exhibit of Californian fruit and vegetables first claimed the attention of the visitor. Many of the fruits and vegetables were preserved in glass jars, not in alcohol but in an aqueous fluid that did not affect their colour. The dried fruits, such as raisins, prunes and figs, were specially well represented. The varieties of fresh fruit were not so numerous as in some of our own shows, but their quality was excellent, especially in the case of the apples. There were large quantities of grapes, many of them of the strongly flavoured Concord variety which would scarcely find a market in this country. The production of grapes in California appears to be greater than is required for wine, as the Grape-Growers' Association is offering considerable prizes for other uses for grape-juice. The growth of seedless oranges has become a large and thriving industry, and seedless apples and gooseberries are now being produced. In this building, if anywhere, one might expect to find the reason why our own fruit-growers are unable to compete with American apples grown several thousand miles away. Professor L. R. Taft, of the Agricultural College, Michigan, a high authority on horticulture, and the chief of this department, was kind enough to give me much interesting information on this subject. The careful grading of the fruit seems to be one of the chief elements of success. Only the finest fruit is put upon the market, inferior apples are used for cider or other purposes. As soon as possible after gathering the fruit is placed in a cooled store where its owner can keep it until the market conditions are favourable. Our own growers flood the market with their fruit at a time when the glut is greatest, and although the quality of their fruit may be even better than that of the imported article the price which they obtain is much lower. A little organisation should change this and a refrigerated store in each of our fruit-growing counties ought to be a highly remunerative undertaking. At St. Louis we had thirty carloads of last year's apples in the refrigerators and some of them were in such good condition that when placed on the show-bench with this year's crop it required an expert to distinguish between them. Another point in which our American competitors excel is in the division of labour. It is the farmer's business to grow the fruit and he does this with the fullest attention to those details which experience and scientific teaching have shown will lead to success. The ground is carefully tilled and manured between the trees and insecticides are used freely, if necessary. When the crop is ripe the farmer's work ends. He sells the fruit as it stands to the dealer who, with the help of his trained hands, gathers it carefully without bruising, grades it, packs the best fruit on the spot in suitable packages, and sends it either to a refrigerated store or in refrigerator cars to the coast for shipment to our markets.

During the summer a fine series of flowers was exhibited, both growing in the grounds and cut in the building. One of the outdoor exhibits was a floral map of the United States, occupying six acres. In each State plants were grown representative of the agriculture of the district.

I will merely mention the *Art Palace*, as I understand that Mr. Isidore Spielmann, Member of the Art Committee of the Royal Commission, will shortly read a paper on the subject before this Society. Those who are the fortunate possessors of Mr. Spielmann's artistic souvenir of the British Art Exhibits at the Paris Exhibition of 1900, will be glad to hear that the description of our excelleut art exhibit at St. Louis is in such able hands. Seventeen nations were represented in the 134 galleries of this building, not only by paintings, but also by statues. France and Germany, especially, had some good pictures. The whole exhibition and its grounds were sprinkled with American statuary, some of which was of striking originality.

Among the art exhibits must be included the Jubilee presents of Her Majesty, the late Queen Vietoria, which had been lent by His Majesty King Edward VII., and which were probably the most popular feature in the whole exhibition. They were exhibited on the first floor of the Administration Building, a substantial stone structure which will become the home of Washington University on the close of the exhibition. The collection has been visited by nearly a million persons, a very large proportion when one remembers that the building in which they were displayed is about a mile from the chief entrance to the exhibition.

In a wing of the same building was the *Hall of Anthropology*, under the management of Prof. W. J. McGee, the distinguished president of the American Anthropological Association. While the building itself contained numerous interesting American remains, especially a unique collection from the pre-historic mounds of Ohio, the chief attraction centred in the various groups of natives collected from

all parts of the globe. First in point of numbers and importance may be mentioned the natives of the Philippine Islands, of whom there were 1,300. A reservation of 47 acres of woodland was set apart for the villages of the Moros, the Bagobos, the Visayans, the copper-coloured head-hunting Igorotes, and the pigmy Negritos. Hairy inus, the primitive white race from the north of Japan, were well represented, also the Patagonian Indians and Esquimaux from Labrador and Alaska. Many tribes of North American Indians were there, and a group of the Osages, the former owners of the exhibition site, came from their reservation to visit the "World's Fair." In preparing the ground for the exhibition a number of prehistoric mounds were removed; some of them were 48 feet in diameter and about 3 feet high.

Perhaps the British policemen formed the most popular anthropological exhibit. A number of well-selected men of the Metropolitan force were in charge of the Jubilee presents and the British Pavilion. After many investigations the local reporters published as a fact that if you asked an English policeman a question you would always get a polite answer, and the consequence was that a large number of visitors tried the experiment with satisfactory results.

The British Royal Pavilion was a replica of the Orangery at Kensington, standing in an old English garden which attracted much attention. Inside the building each room was fitted up in a style representing a certain epoch, both as regards decoration and furniture. The construction of the building was much more durable than that of the other structures, Portland cement having been substituted for plaster of Paris. Among the other buildings of foreign States may be mentioned the French Pavilion, a replica of the Grand Trianon; the German Pavilion, a copy of Charlottenburg Castle, containing an interesting collection of furniture and presentation plate, and the Brazilian building. Most of the States of the Union had buildings, some of which were of considerable size and architectural merit. Altogether there were said to be more than 1,500 separate buildings on the grounds.

No account of the "World's Fair" would be complete without some reference to the Pike. This was a street, or rather village, about a mile long adjoining the main entrance to the exhibition. The buildings composing it were all places of amusement or entertainment. Some of them, such as the Tyrolean Alps, Hagenbeck's Menagerie and the Irish Village were well worth visiting, but from the majority one emerged with a feeling of disappointment. Among the out-door exhibits of a scientific character one of the most notable was Professor M. A. G. Himalaya's solar furnace. This consists of a large parabolic reflector composed of more than 6,000 pieces of silvered glass, the whole being fixed on a pivoted axis. In the focus of the mirror is a furnace in which Professor Himalaya hopes to obtain even higher temperatures than those which can be produced by means of the electric arc. He has been working on the subject for several years with remarkable perseverance, and we must wish him success in his efforts to extend the limits of human knowledge.

I feel sure that you will join me in thanking the Royal Commission for the St. Louis Exhibition for permission to use some of their photographs. I am especially grateful to Colonel Watson, the British Commissioner at St. Louis, for much valuable information and assistance, and Mr. E. J. Lloyd has kindly sent me some photographs of objects of special interest.

There were innumerable other things of interest at St. Louis to which time will not permit me to refer. I trust that the brief sketch I have given has been sufficient to show that the hope expressed by our president, His Royal Highness, The Prince of Wales:—"That the representation of this country in the various departments of the exhibition may be worthy of the British Empire," has been fulfilled.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that in November, 1903, he had the pleasure of listening to the address delivered before the Society by Mr. George F. Parker, on the subject of the St. Louis Exhibition, and in the course of the subsequent discussion he referred to the difficulties which the various Committees of the Royal Commission had experienced in organising representative exhibits, pointing out that in the case of the group with which he had been concerned, namely, that of chemical and pharmaceutical arts, success would probably not have been achieved if exceptional facilities had not been afforded by the Royal Commission. Even with that help, unremitting labour was needed for many months, and he was very glad to know the author considered it a question well worthy of careful consideration, whether some steps could not be taken to preserve something like continuity of effort, or at any rate, to create such a permanent organisation as would render it comparatively easy on a future

occasion to start from the point at which they had now arrived, and thus to have available the experience which had been gained. Obviously the first step in that direction was to procure a general recognition of the principle that international exhibitions, with sufficiently long intervals, were desirable. The prevailing tendency unquestionably was for manufacturers to regard them as evils, and with that sentiment he had considerable sympathy; but he was of opinion that they should be regarded as necessary evils, and if there was an agreement on the point it appeared to him to follow that they should participate in them. That being granted, the next step was to realise that if they took part their co-operation must be full and complete, for half-hearted, reluctant action might easily become worse than abstention. He submitted that it was in the second step that Great Britain had shown weakness in the past. When he spoke on the occasion to which he had referred he ventured to say that the sub-committee over which he presided had been stimulated to special effort by the determination to show that the comparatively unsatisfactory character of British chemical exhibits at recent exhibitions was due to British apathy and not to British industrial decadence. He admitted that ground had in the past been furnished for the contemptuous attitude of mind of foreign competitors in chemical industry towards this country, and he indicated that the exhibits at St. Louis would remove that reproach and demonstrate that Great Britain could still venture to put herself in comparison with other countries as possessing exceptional advantages in the conduct and development of the industry in question. The statements of the author, coupled with the long list of awards, had amply justified the view to which he gave expression, for England had shown the world that, even with such a formidable competitor as Germany, it could hold its own, and he was sure there were none present who were not satisfied that a full equivalent had been obtained for the labour and expense which it had involved. It was impossible to measure the direct commercial benefits accruing to the manufacturers who had so loyally and effectively collaborated with the Royal Commission in giving effect to the wishes of the Prince of Wales, but that those benefits must be large and far-reaching could not be doubted. As had been pointed out in the preface to the descriptive catalogue of chemical and pharmaceutical exhibits, the manufacturer had been enabled to judge whether he was gaining ground, or was being distanced by his competitors at home and abroad, and had thereby been placed in a position to make suitable provision for the future. If, therefore, manufacturers would admit that participating in international exhibitions should be recognised as forming part of the routine work incidental to their business, they had to consider how it could be simplified and rendered more effective. Strong exception had, in the past, been taken in this country to the practice of forming collective representative exhibits, which had long been successfully carried out by some other countries, but he ventured to think that the principle, which had been for the first time adopted by the Roy Commission in organising the exhibits at St. Lou and especially the chemical exhibits, namely, that o collectivity without sacrifice of individuality, had been shown to be free from objection. As was stated in the preface, the system of grouping adopted had been found to facilitate the study of the exhibits, and to add largely to their educational value. It must not be assumed that in preparing collective exhibits in that new form there was any less need for the exercise of independent thought on the part of the exhibitor, or less opportunity for the display of individuality; it had, in fact, been shown that the exhibitors in the chemical section, in responding to the appeal of the Royal Commission, had aimed with conspicuous success at furnishing an instructive series of illustrative specimens, as well as the ordinary selection of commercial products. To insure success in carrying out the principle of collectivity, it was essential that the organising arrangements should be in the hands of committees who were not merely conversant with the industries to be represented but also had full knowledge of the various firms engaged in those industries. It was evident that the hope of advancement of material interests rendered those firms most willing to participate which were least qualified to pose as representatives of the particular trade or branch of commerce in which they were engaged, and it would readily be understood that as the primary object must be the national one of demonstrating what any particular branch of British industry was doing, or could do, in comparison with what was accomplished by other countries, everything depended upon the judicious selection of exhibiting firms. If collective exhibits illustrative of British industries were to be a feature of future international exhibitions, it would appear to be desirable that there should be some permanent organisation, such as the author had suggested, to preserve and extend the knowledge and experience of procedure already gained. The appointment of a joint standing committee would be one way of accomplishing that end, and he submitted that some action in that direction might fittingly be initiated by the Society of Arts.

Mr. H. J. HELM said that as Mr. Reid's colleague he would like to emphasise the importance of the preparatory work that was done in London before they left England. He was quite sure that any success that Mr. Reid and himself might have attained at St. Louis was more than half won by the work that was done in committee rooms in London before they started for America. He wished particularly to mention the admirable catalogue and the splendid articles on the technology of the various industries that were represented. They not only admired the catalogue themselves, but took care that every member of the jury should have it in his posses-

sion in time to read and study it before he criticised the British exhibits. The exhibits were admirable, but there was no exhibits in the whole of the exhibition that were more admirably displayed, and more compactly arranged, than those belonging to the chemical and pharmaceutical section of the British exhibits, and a visitor in that section saw, with very few glances, more than he could have seen of the exhibits of almost every other country by wandering from one building to another. The American exhibits, although good separately, were scattered over so many buildings that they very largely lost their importance. He thought the exhibitors in this country who sent their goods to the exhibition were deeply indebted to the sub-committee of the Royal Commission, which made such admirable arrangements, and which, in his opinion, won half the battle. He also wished to confirm everything the Chairman had said as to the admirable fitness of his colleague for the position that he held on the jury at St. Louis. Mr. Reid had many qualifications which he had not. In the first place, he had not only a very large amount of tact, courtesy and discretion, but a wonderful knowledge of languages which enabled them to tide over many difficulties with the jury which would otherwise have seemed insuperable. He had never had a more admirable colleague to work with.

Mr. J. W. Lovibond wished, as one of the exhibitors, to expresss his deep sense of obligation to the members of the Royal Commission for the care which they gave to the interests of British industry; until he saw the photographs and heard the paper, he was totally unable to realise the extent of their labours and the obligations which rested upon them.

Sir Henry Wood (Secretary of the Society) thought that if exhibitions were to be held in the future, the success of any national section rested entirely upon the way in which the exhibits were organised into collective exhibits. That fact became perfectly evident to all who studied the working of exhibitions at the great French Exhibition of 1889. England was, proverbially, rather slow in learning lessons from other countries, but he thought they were to be congratulated that those who had to do with exhibitions in this country had at length learnt that lesson, which ought to have been learned in time for the exhibition at Chicago in 1893. The Royal Commission at that time had no funds with which to undertake the organisation of such exhibits, but some efforts were made to induce localities or classes of exhibitors to arrange themselves into collective exhibits. He was sorry that the efforts failed, and how they failed might be instanced by one example. There was one particular class of manufacture, in which this country made a very excellent show at Chicago, and there were three or four large exhibitors who were ready to exhibit, and did exhibit. He did his best to induce those exhibitors not to join together in one exhibit, but to allow their exhibits to be combined into some sort of harmonious whole. Certain of the exhibitors agreed, but one of the most important said at once that if anything of the sort was attempted he would have nothing to do with the exhibition. The result was that there were separate and independent exhibits, all of a very high class, but the section as a whole lost a great deal from the want of harmony which might have been brought into it. As one who had a good deal to do with an American exhibition more than ten years ago, he should not like to refer to exhibitions in America without bearing his testimony to the kindliness and fraternal good feeling with which English representatives in America had always been received. It was so in the first great American exhibition, the centenary exhibition at Philadephia, and it was equally so, as he knew best of all men, in the exhibition at Chicago, and he had not had the slightest doubt it was so at St. Louis. The British section at Chicago, the only exhibition in America with which he was personally concerned, was a foreign section like the rest, but the representatives of Great Britain were not looked upon as the representatives of a foreign country; they were regarded, and he believed they regarded themselves, as individual members of the staff of the exhibition, and he always considered it a very great honour, and a very great piece of good fortune, to be constantly consulted, and to place such experience as he possessed at the disposal of the managers of that great exhibition. He had no doubt that the same feeling existed at St. Louis, and if another exhibition was held he had not the slightest doubt but that the British staff and the British Commission would be regarded as portions of the staff of the exhibition, and not as aliens or outsiders. With regard to the beautiful buildings of which pictures had been shown, nobody who had not seen the two last great exhibitions of America could compare the two, but he could not conceive any exhibition, past or future, which presented a more splendid architectural appearance than the exhibition of Chicago, as viewed from the great inland sea, on the shores of which it was placed. He, indeed, doubted whether there were any buildings in the world at that time which, regarded from a sufficient distance, a mile or so out on Lake Michigan, presented a more splendid architectural effect than those apparently magnificent palaces which were erected at Chicago in 1893. As one who had had a great deal of experience of exhibitions in the past, he wished to congratulate the author of the paper first, upon the excellent way in which he had presented a very complicated subject, and secondly upon the manner in which he had conducted one of the most difficult duties connected with exhibitions, namely, that of successfully carrying out the work of the jury.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Reid for his able paper.

Mr. REID, in reply, said that his colleague and friend, Mr. Helm, had given him far more credit than he deserved; he never wished to have a more laborious and painstaking colleague than Mr. Helm on the work of any jury. He wished to endorse every word Sir Henry Wood had said with regard to the way they were treated in America; they were treated not only as cousins but as brothers. Everywhere they went they were received with open arms, and the difficulty was that they had to refuse so much hospitality that he feared some of the hosts were disappointed.

MILK IMPURITIES

One of the most difficult and important problems of the day is how to secure pure milk in sufficient quantities to meet the needs of the rapidly increasing population. So far as quantity is concerned, townsmen have no cause of complaint. They can get as much milk as they want at reasonable cost, but in many country districts the villagers find it difficult, if not impossible, to obtain a sufficient supply. The milk is sent away to meet the town demand, and they have to be content with the preserved product. But it is the quality of the milk that gives the gravest cause for anxiety. No doubt too much can be made of the impurities to be found in much of the milk supplied to London and the great centres of population. The dangers to life lurking in the milk pail and the milk shop are many and serious, but it may go some way towards reassuring the timid, alarmed by gruesome analysis, if they are reminded that, although milk swarms with bacteria, most of them are harmless. Dr. Vincent, who is Physician to the Infants' Hospital at Hampstead, and has given much attention to the subject, says that no matter what precautions are taken, you cannot get away from bacteria. It is not those bacteria which cause injury; lactic acid bacteria helps the infant, without them it is probable that no infant would live. The danger lies in the development of bacteria, and this can only be prevented by precautions that are very general on the Continent, more especially in Denmark and Sweden, but are not as yet commonly adopted in this country. "It is incredible," said Mr. Justice Grantham in his charge to the jury in a recent case, "that cows are allowed to be milked in such surroundings, and their milk sent to London."

Before considering the best means of removing the abuses complained of, it may be useful to cite some of the evidence as to the conditions under which milk is obtained and distributed to the public. The origin of the trouble is in the indifference of the farmer to cleanliness. In her evidence before the Inter-Departmental Committee, Mrs. Watt Smyth makes some very strong observations on this point, and although they are much too sweeping, it will be allowed by those acquainted with farms that the following description applies to many of them:—

"The cows are in a most filthy condition, standing in the manure, and the cowsheds, the stalls, are covered with manure, and outside the yards are heaped up with it. There is no proper ventilation, the milkers are filthy, their hands and clothes are dirty, and their vessels very often are dirty."

And Dr. Newman, Medical Officer of Health for Finsbury, who has conducted an inquiry into the milk supply of the borough, arrives at much the same conclusion:—

"There is evidence to prove that, as a general rule, the country cowsheds from which the milk is derived are ill-lit, over-crowded, badly ventilated, and badly drained. There is little or no guarantee that the milk is derived from healthy cows."

Nor are the risks of contamination over when the milk has left the farm. Much of the milk consumed in the poorer quarters of London is three or four days old, and it has passed through the hands of several dealers by each of whom a dose of some preventive has been added in order to prevent the actual onset of decomposition. "The mischief," says Dr. Priestley, Medical Officer of Health for Lambeth, "is caused by the many hands through which it passes. If there were some system of collecting milk in the country and sending it straight to milk depôts, it would be better." The evil is not at an end even when the milk reaches the home of the consumer. As the report of the Committee points out, "a pure supply may be rendered injurious by dirt in the house, the proximity of contaminating articles, the general ignorance in fact that prevails as to how milk should be stored, and the conditions under which it is fit for use."

The first thing to be done is, as many urge, to reform farm practice, to compel the farmer to do certain things to insure the purity of his milk. To compel, because, without compulsion, the majority of farmers will not move in the matter. But assuming this, how is the necessary pressure to be brought to bear upon them? Before the local authority can move the medical officer must report, and, oftener than not, when his report is received it is pigeon-holed. Speaking generally, the local authority is not in much sympathy with reform, and will do little in its direction without the pressure of public opinion, and that seldom exists. True, the medical officer may write to the Local Government Board, and if the local authority persistently ignores his representations it is his duty to do so. But his position is a very difficult one. Except in London he can be dismissed by the local authority without cause shown, and he would be dismissed if he took up a hostile attitude towards his employers and appealed to the Local Government Board to put pressure upon them to do that which they have no wish to do. It would seem desirable to make medical officers independent of the local authority so that they may do their duty without risking the loss of the means of livelihood.

But as the law stands the Local Government Board itself can do little against a local authority bent upon doing nothing. The Local Government Board may make orders for the registration of cowkeepers, dairymen, &c.; for the inspection of cattle in dairies, and for prescribing and regulating the lighting and ventilation, cleansing, drainage and water supply of dairies and cowsheds; for securing the cleanliness of milk stores and vessels. It has issued model bye-laws for urban and rural districts respectively. But the legislation under which it acts is permissive not mandatory. The Board may advise, it cannot compel. The report of the Inter-Departmental Committee on Physical Deterioration recommends that in the event of the local authority not making orders, the Local Government Board shall make the orders themselves, or if it is deemed preferable to bring indirect pressure to bear, the power now possessed by a local authority under the Infectious Diseases (Prevention) Act, 1890, for prohibiting the supply of milk from an infected dairy might, in the opinion of the Committee, be extended, so as to cover exclusion of supply from areas where provisions of the Contagious Diseases (Animals) Act are not in operation. Under either alternative the Committee consider that the County Council should be empowered to act in default of the local authority, and it should be the duty of the Local Government Board to intervene in the ultimate resort.

The crux of the question would seem to lie in the power to enforce the regulations necessary to preserve milk against contamination, and how to provide *ab initio* for the purity of milk. In expert opinion, the first step to be taken with milk on its leaving the cow is prompt refrigeration to a temperature of 40 degrees Fahrenheit. This was advocated by Dr. Cantley in the paper he read at the Royal United Service Institute last week. The enforcement of this procedure would stand in the way of the small cowkeeper sending his milk to the agents of the great collectors who serve the urban market, but having regard to the scarcity of milk in rural districts it might be a good thing if these small men had to look to their neighbours to purchase their milk. Dr. Cantley contends that the only plan for dealing with the matter thoroughly is to municipalise the milk supply. "Its management should pass as soon as possible directly into the hands of the municipal authorities, rather than through the intervention of milk companies which would eventually have to be bought up in the same way as the water companies." That is a very big suggestion, and although at Battersea, and some other places, steps have been taken in this direction, it may be thought better, for the present anyway, to work on less ambitious lines. It is to be regretted that our farmers have not seen their way as yet to co operation. The wonderful development of dairies in Denmark is largely due to the co-operative system. This system was adopted to meet the want of organisation felt by the farmers and has proved eminently successful. Denmark led the way, Sweden followed, then Germany, and in all these countries the resulting success has beeen great. Sir Horace Plunkett, and the Department of Agriculture, are moving in the same direction in Ireland. Under the co-operative system, as worked in the Continental centres named, there is constant inspection of dairies by officials of the societies. The utmost care is taken to ensure the proper feeding of cows, and to guard against contamination. The management of their cows and milk-sheds by many English farmers leaves little or nothing to be desired, but the majority are less alive to what can and ought to be done in the way of protection against contamination. They would find it to their advantage to be more abreast of the times; and now that the public are beginning to realise what a pure milk supply means to the health of the country, it may be expected that Parliament will be asked to give the Local Government Board those fuller powers which will enable it in the last resort to apply effective pressure in order to bring about changes necessary to the public health.

ELECTRO-THERMIC PROCESSES FOR IRON AND STEEL MANUFACTURE.

The receipt, in London of the publication by the Department of the Interior of the Dominion of Canada, of the Report of the Commission sent to Europe "to investigate the different electro-thermic processes for the smelting of iron ore and the making of steel," almost exactly synchronized with Sir William Abney's address to the Society of Arts, on the relations between the State and scientific research. This report is significant in many respects. It is, perhaps, an almost unique example of the Government of a self-governing British colony appointing a Commission to investigate manufacturing processes, and to report on their probable utility as a factor in the development of a promising metal-working industry within the colony. It is also noteworthy, as an instance of a Government Department investigating a scientific and commercial problem through a committee of experts directly selected, rather than through a recognised scientific institution.

In its entirety, the report covers, with its appendixes, over 220 large crown 8vo. pages, is illustrated by 24 plates, and 29 diagrams. The story of the genesis of the Commission may be briefly told. At the end of 1903, the Hon. Clifford Sifton, Minister of the Interior, instructed Dr. Eugene Haanel to proceed to Europe to investigate this problem, taking with him an electrical engineer, a draughtsman, and a private secretary. On arrival in England, a competent metallurgist was to be engaged. Mr. F. W. Harbord, of Cooper's-hill, the consulting metallurgist and analytical chemist to the Indian Government, filled this post.

The Commission immediately proceeded to Sweden,

to investigate the Kjellin process at Gysinge. Here high-class steel is made by melting charcoal pig and scrap iron in electric furnaces of the induction type, *i.e.*, in furnaces without electrodes, in which the metal to be treated acts as the secondary coil of an alternating current transformer. The quality of the steel produced by this process depends entirely upon the purity of the compound materials employed. The process therefore corresponds to the crucible steel process, save that the melted material is at no time during the operation exposed to the furnace gases, which, if absorbed, deleteriously affect the quality of the product. Mr. Harbord reports that the estimated cost of steel produced at Gysinge is 34 dols. per ton of 2,000 lbs.

The Commission next proceeded to Kobfors—also in Sweden—where the Héroult process of making steel had been in operation. At the time of the visit, owing to the large stock of electric steel, the works were engaged in producing ferrosilicon. It was therefore at La Praz, in France, that the Héroult furnaces were examined. Steel is there made from scrap, melted down, and carbonized by carburite. The electrodes consist of square prisms made from retort coke, costing ten centimetres per kilogramme when manufactured. A demonstration was given at La Praz of the production of pig iron.

The most important experiments witnessed by the Commission were those made by Keller, Leleux and Company at their works at Livet. Some 90 tons of iron were used for the various experiments made to demonstrate the commercial feasibility of making pig iron and steel direct from the one by the electric process. The furnace is of the resistance type, and consists of two iron casings of square cross section lined with a refractory material and communicating with each other at their lower ends by means of a lateral canal. In starting the furnace the charge is introduced between the carbon blocks at the base of each shaft, and the electrodes which are then in their lowest position. The current passes from one electrode through the material to be reduced to the carbon block, and thence passes outside of the furnace by means of a copper conductor to the other carbon block through the charge in the second shaft to the other other electrode. The resistance which the charge offers to the passage of the current heats the charge, and the reduced metal flowing along the canal then conducts the current internally from one electrode to the other electrode. The electrodes are formed by an assemblage of four electrodes of square cross section, forming a single mass 850 mm. by 850 mm. by 1·4 meters long. The inventor stated that the electrodes employed for a furnace having an output of 10 tons in 24 hours will last 20 days.

Three sets of experiments were made before the Commission. In the first, iron ore was electrically reduced, yielding grey, white, or mottled pig iron as desired. In the second set, the iron ore was electrically reduced with a definite amount of carbon in the charge, with a view to ascertaining the amount of electric energy absorbed in the production of one ton of pig iron. In the third set, ordinary steel of good quality was produced from the pig iron manufactured in the preceding experiments.

The Stassano furnace at Turin was visited, but was not in operation at the time of the visit of the Commission. The Harmet and Gustave Gin processes, both described in the appendixes to the report, were not in operation at any plants at that time.

In a very concise summary, which follows, the detailed descriptions of the various tests (both from the commercial and from the metallurgical standpoints), Mr. Harbord expressed his general conclusions. These may be summed up in the following abstract:—

Steel, equal in all respects to the best Sheffield crucible steel, can be produced by the Kjellin or Héroult, or Keller processes, at a cost considerably less than the cost of producing high-class crucible steel. However, in the present state of the industry, structural steel cannot be produced in the electric furnaces, at a price which will compete with Siemens or Bessemer steel. Therefore, so far as steel is concerned, the electric furnace can only be used commercially for the production of very high class steel for special purposes.

The reactions in the electric furnace, in regard to the reduction and combination of iron with silicon, sulphur, phosphorus, and manganese are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature (by varying the electric current), any desired grade of iron, grey or white, can be obtained, the change from one grade to another being effected more rapidly than with the blast furnace, which would contain a much heavier charge.

Grey pig iron, suitable in all respects, for acid steel manufacture, either by the Bessemer or Siemen's process, or for foundry processes, can be produced. When pig iron, low in silicon and sulphur, is needed for basic processes, it can be produced, provided that the ore mixture contains oxide of manganese, and that a basic slag is maintained by suitable additions of lime. Mr. Harbord even goes so far as to express his belief that pig iron for basic processes can be produced even in the absence of manganese oxide in the iron mixture, provided that a fluid and basic slag be maintained.

On the commercial side, Mr. Harbord's conclusions are of special value. "Pig iron can be produced on a commercial scale, at a price to compete with the blast furnace, only when electric energy is very cheap, and fuel very dear. On the basis taken in this report, with electric energy at ten dollars per electrical-horse-power-year, and coke at seven dollars per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases where

ample water power is available, and blast furnace coke is not readily obtained, electric smelting may be commercially successful. It is impossible to define the exact conditions under which electric smelting can be successfully carried on. Each case must be considered independently after a most searching investigation into local conditions, and it is only after these are fully known that a definite opinion as to the commercial possibilities of any project can be given."

Dr. Haanel controverts none of these points in his own summary. He does, however, emphasise the fact that the experiments at Livet were carried out in furnaces not specially designed for the production of pig iron from iron ore. An inproved furnace would, in Dr. Haanel's opinion, give even better results. So far as cheap power is concerned, Dr. Haanal states that he is credibly informed at the Chats Falls, near Ottawa, the water power can be converted into electrical energy at four-and-a-half-dollars per electrical horse-power per annum. If this is really the case, the report of this Commission will mark the beginning of a keen struggle for the iron and steel market of North America, between Canada and the United States.

The Canadian Government in appointing this Commission has acted for the benefit of the Empire generally. British over-sea colonies and possessions cannot yet boast great iron industries. However, where ore is plentiful, and water power sufficiently cheap—as it may become, in course of time, in Southern India—fairly large local industries may, and probably will, spring up.

AGRICULTURAL EDUCATION IN CANADA.

It is reported from Ottawa that the millionaire tobacconist, Sir William Macdonald, is about to establish at St. Anne's, some twenty miles from Montreal, an institution, to be known as the Macdonald Foundation for Rural Education. For this purpose 700 acres of land has been bought, and a million dollars are to be spent in the completion of the scheme. Sir William Macdonald—who was knighted in 1898—has already given between two and three million dollars for educational purposes to the McGill University, and built and maintains the Macdonald Institute at Guelph for women desirous of taking a course analogous to that provided at the Ontario Agricultural College for Men. The new institution is expected to serve for the Province of Quebec a purpose analogous to that served by the college and farm at Guelph for the Province of Ontario. Mr. Robinson resigns his position as Dominion Commissioner of Agriculture to become principal of the new foundation. For some time past he has been identified with the establishment of schools for instruction in manual training, the encouragement of nature study, and consolidated rural schools, Sir William Macdonald providing the funds.

Sir William Macdonald's intention at St. Anne's is to found an institution where scientific instruction in all branches of agriculture can be given, and original research conducted. The experimental station will, of course, be available for varied experiments in the growing of crops. Only last month the new consolidated rural school at Guelph, which owes its existence to the munificence of Sir William Macdonald, was opened for school purposes. Professor Hodgson, of McMaster University, has been appointed Principal, and the experiment to be carried on by the school will be watched with much interest. There will be a consolidation of four school sections under one roof, and a staff of teachers doing the work that was formerly done by one teacher in each of the rural schools. It is hoped that this system, when understood, will be adopted by the various school sections throughout the province. By amalgamating, several school sections can erect a suitable building, have graded classes, and give to the rural scholars a much more efficient education than would be possible under the present method of one school to a section. The subjects taught go beyond the ordinary country curriculum. The main idea is to adapt education to rural needs, and endeavour to teach the children so that they will be in sympathy with country life, and not be so anxious to leave the farm. In amalgamating several school sections the difficulty of getting the scholars to school arises, but this is obviated by bringing the children in large vans. The school has six of these vans, and they call for the children within a radius of 5½ miles. The van calls at every farmhouse where there are children. Under this system of bringing children to the school the trouble, so marked in country schools in sparsely populated countries like Canada, of irregularity of attendance, will, it is hoped, be overcome. There is no age limit, but the school is confined to rural children. While similar schools exist in several American States, and in New Brunswick and Nova Scotia, the Macdonald school goes a step further in instruction, as it includes gardening, each pupil having a little plot of ground to be cultivated by himself.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in September and October last:—

New Charts.—Diagram to facilitate the obtaining a ship's position by Sumner's method. 3239 to 3250—Monthly wind charts for the South Atlantic ocean; twelve charts bound together in an atlas. 3427—France, north coast:—Rade de Brest. 3383—Nova Scotia:—The gut of Canso. 3450—West Indies; Cuba, South coast:—Ensenada de Mora. 3454—Central America:—Plans of anchorages on the north coast of Panama. 3447—British Columbia; Vancouver's island, east coast:—Moresby passage with

its approaches. 3448—North America, west coast; Queen Charlotte sound:—Blunden harbour. 3430—North America; Vancouver's island:—Galetas and new channels. 3443—North America; Vancouver's island:—Nawhitti bar; Bull harbour. 3452—Persian Gulf entrance:—Khor Kawi anchorage. 3456—Bay of Bengal, east coast:—Cox's Bazar. 3453—Malacca strait:—Klang strait and approaches. 3368—Philippine islands; south part of Luzon island:—Batan I. to San Bernardino I., and Himagaan bay to Inamok. 3459—China, south-east coast; Hong hai bay:—Sam chau inlet. 139—Japan:—Ikitsuki jima to Taka shima, including the northern approaches to Hirado kaidyo. 3438—Japan:—O shima to Furubira wan. 3409—Japan:—Ishinomaki wan (Sendai bay) and Sakata ko to Tsugaru kaikyo (strait). 3439—Solomon islands, Ysabel:—Austria sound (plan, Allardyce harbour). 3455—Pacific ocean; Loyalty islands, Uvea atoll and Beautemps-Beaupré island. 1751—Rio de la Plata; Saucé point to Martin Garcla island (plan added, Saucé harbour). 1881—Indian ocean; Cargados Caragos islands (plan added, Agalega islands). 3031—Bays and anchorages on the east coast of Borneo (new plan, Buja and Manimbora anchorages). 1384—Pacific ocean, Loyalty islands; anchorages in (plans added, Dokin bay, Gaatcha bay, Ro bay, Poane bay, Aui bay).

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

Nos. 1188—The World; coal and telegraph chart. 2212—England, south coast; Teignmouth. 1776—Færoe islands; Trangjisvaag. 3159—Norway; Torbiornskier to Jœlöen. 3160—Norway; Torbiornskier to Ranö. 2300—Baltic; Gulf of Bothnia; sheet V., Stiernö point to Fiädeiág, &c. 2302—Baltic sea; sheet VII., Tome point round the head of the gulf to Tauvö. 3345—France, west coast; Chenal du Four. 274—North Polar chart; Atlantic side. 278 - North Polar chart; Pacific side. 2740 - Iceland and the Færoe islands. 2976—Iceland; Snefells Jökel to North cape. 2977—Iceland; North cape to Sigle fiord. 275—America, north coast; Smith sound, Kennedy and Robeson channels. 2564 - United States America, east coast; Delaware river; sheet II. 528—South America; sheet IV., Maranham to Pernambuco. 1911—United States, west coast; Approach to Juan de Fuca strait. 2908—Africa, south coast; Port Natal entrance. 2757—Banka strait to Singapore. 941*a*—Eastern archipelago, western portion. 941*b*—Eastern archipelago, western portion. 2637—Celebes; Strait of Makassar, south part. 1466—China, east coast; Hongkong; Fotaumun pass. 2409—West coast of Formosa and Pescadores channel. 913—Korea, west coast:—Mackau group to Clifford islands. 104—Korean archipelago, southern portion. 3365—Korea, south-west coast:—Port Hamilton to Mackau group. 980—Caroline islands.

These charts are issued by Mr. J. D. Potter, 145, Minories.

CORRESPONDENCE.

THE BRITISH CANALS PROBLEM.

In Mr. Lee's interesting paper on "The British Canals Problem," reported in the *Journal* of the 2nd instant, he seems to tacitly assume that a canal becomes derelict solely through neglect, deliberate or otherwise, and that no account need be taken of the effect of the speedier and more convenient competitive form of transit offered by the railway on the slow and cumbersome means afforded by the canals. There is no doubt that many of Mr. Lee's contentions are perfectly just, but it appears to me that a great deal too much has been imputed to "deliberate neglect" in describing the present condition of English waterways. I submit that in most cases a canal becomes derelict simply because it has ceased to be of use, just as the stage coach, for a similar reason, disappeared on the introduction of railways. It is impossible, indeed, that the canals can ever regain the importance that belonged to them when they constituted the only means for the inland transport of heavy goods. To advance extravagant claims in their favour is merely to defeat the object which Mr. Lee has in view.

In the paper, French waterways were referred to. I should like to mention a few important facts which Mr. Lee omitted. In the first place, the French waterways are quite unlike our own—they are mostly inter-dependent. In the second place, their chief use is not for through traffic, but is almost entirely local, or between particular points for certain special articles. It has also to be borne in mind that over 90 per cent. of French canal traffic is on first-class navigation, and the enormous length of secondary waterways, constituting three-fourths of the whole system, is wholly out of proportion to the necessities of transit. Another important fact is that the English canals carry half as much again in tonnage as the French, and yet, as Mr. Lee pointed out, France has spent many millions on the improvement of her navigable and artificial waterways. Has the increase of traffic been in proportion to the capital expenditure?

In these days of rapid transit the desperate slowness of canal transport constitutes its main disadvantage, and this is experienced in France just as much as in this country. To send goods by canal from Rouen or Havre to any point on the central canal system occupies any time from three to six weeks. Delay means expense, and until canal transport makes some approximation in the matter of speed, I will not say to the railway, but even to the road, traffic will naturally be diverted more and more into other channels.

After making full allowance for canals which have become derelict because they are practically useless, and also taking into account the disadvantage just mentioned, there is no doubt that the utility of our waterways could be largely increased, but I venture to assert

that in view of the alarming growth of municipal expenditure, it would be a disastrous policy to give still further powers to the local authorities to add to their already heavy burden of debt. What data can Mr. Lee supply to show even a probability of a sufficient increase of canal traffic to justify such a course? In the present state of national finance, however, something more than a probability is necessary before incurring expenditure when the return may not even be sufficient to pay the interest.

When reform is needed in certain directions the first suggestion in most cases is to give the local authorities power to spend more money. The local authorities have already spent too much. In view of the undoubted limitations of canal transport it seems to me quite unnecessary to plunge into a course of expenditure when other means can be adopted. Granting that the railway companies place obstacles in the way of the full and legitimate use of the canals, the remedy is obviously to compel the companies to remove those obstacles and reduce their rates. If the private owners have a fair field for their enterprise they will not hesitate to incur expenditure on the improvement of their property, but if, from any natural circumstance, a canal cannot compete with the railway, or attract to itself a certain class of traffic, it will become derelict, and no artificial means of resuscitation will save it. At all events I submit that the remedy for whatever neglect exists is not to be found in giving *carte blanche* to the local authorities to add still further to their burdens and those of the community in general.

W. D. McConnell.

64, Burma-road, Clissold-park, N.
Dec. 6th, 1904.

GENERAL NOTES.

Society of Musicians.—The Incorporated Society of Musicians will hold its Twentieth Annual Conference at Manchester from January 2nd to 7th, 1905. Addresses will be delivered by Sir Frederick Bridge, on "A Weak Point in our Musical Education"; by Mr. W. A. C. Cruickshank, Mus.B.Oxon, on "The Progress of Music during the Nineteenth Century"; by Mr. James Dawber, Mus.B. Cantab, on "The Advisability of still further Safeguarding the Entrance to the Musical Profession"; by Mr. T. Henderson, Mus.B.Dunelm., on "Some Blots upon English Music"; and by Mr. S. Midgley, on "Municipalities and Music."

Automobiles for the Ceylon Government.—Up to mid-day on February 1st, the Government of Ceylon are open to receive tenders for the conveyance of mails and passengers between certain points in the island. There are five distinct sections, (1) between Bandarawela and Badulla, a distance of 18 miles, twice daily in each direction; (2) from Badulla to Bathcaloa, a distance of 105 miles, once daily each way; (3) from Matale to Trincomalee, a distance of 97 miles, once daily each way; (4) from Colombo to Chilaw, 50 miles, twice daily each way; and (5) from Chilaw on to Puttalam, a further 32 miles, once daily each way. The proposed service is required to commence on 1st July, 1905, the contract being for ten years.

Armorial Bearings.—Armorial bearings for Manitoba have been approved at the Heralds' College, and the Warrant authorising their use is about to be signed by the King. Similar action in regard to armorial bearings for British Columbia and Prince Edward Island will shortly be taken. These three provinces adopted armorial bearings without authority, hence they could not be embodied in the Coat of Arms of the Dominion. As soon as entry is made in the Heralds' College, and a Royal Warrant issued, the Arms of Manitoba, British Columbia, and Prince Edward Island can appear in the Dominion Shield. The four original provinces were granted armorial bearings in 1868. Mr. Joseph Pope, C.M.G., Under Secretary of State of Canada, has been working for several years to induce the three provinces to apply for approval of their heraldic devices.

Historic Ground.—There is fear of another fall of rock at Quebec, and Lieutenant Amio, of the Geological Survey, has been instructed to make a thorough examination of the cliff with a view to the adoption of such measures as will prevent a recurrence of the slide of 1889. There is a curved strata on the face of Cape Diamond which follows an upward turn, and at the foot of the King's Bastion dips towards the river. Since 1889 several crevices have developed at the King's Bastion which extend in a direction parallel with the foot of the citadel. There are other crevices underneath the west corner of Dufferin-terrace. The suggestion has been made that if the face of the cliff is cemented over it will prevent water from percolating through the fissures and further movements taking place.

American Wheat Exports.—Referring to the article on the British Wheat Supply that appeared in the last issue of the *Journal*, reports prepared by the Department of Commerce and Labour (U.S.), and just issued, show that the total exports of wheat during the nine months ended September 30 last were less than 10,000,000 bushels, as against 55,000,000 bushels in the corresponding months of 1903, 96,000,000 bushels in the similar period of 1902, and 139,000,000 bushels in the nine months to September, 1901. Even flour exports are beginning to show the effect of the great shortage in the wheat supply available for exportation, and for the nine months ended September they amounted to only 9,000,000 barrels as against 13,500,000 barrels in 1903.

Starlings in New South Wales.—The Government Entomologist of New South Wales, reporting to the Ministry of Agriculture, refers to the rapid increase in the number of starlings, and the injury they do. First imported from the Mother

Country not so very many years ago; starlings swarm in Victoria, and are gradually spreading northwards. Flocks of them have recently appeared in Sydney orchards and gardens. They are the greatest enemy of the fruit-growers, who have to cover their trees with nets (while the fruit is yet green) to keep the birds off. They are also claiming the attention of squatters who say they perch on the back of sheep and pluck out tufts of wool (presumably for nest lining), thus damaging the best part of the fleece.

HISTORIC HOUSES IN LONDON.—In May of last year the London County Council sanctioned the erection of a tablet at No. 122, Great Portland-street, in memory of James Boswell, the biographer of Samuel Johnson. The house in question, however, though occupying the site of the premises in which Boswell lived and died, is a comparatively new building; and before taking any action under the authority of the Council the Local Government Records Committee took into consideration the question whether it was desirable to continue the practice adopted in several instances by the Society of Arts of indicating such houses. As a result it was felt that, while there were in London so many cases in which the Council had the opportunity of erecting a tablet on houses which had actually been the residences of distinguished individuals, it was not desirable at present to take action as regards premises whose only claim to distinction was that they stood on the site of houses formerly occupied by the persons whom it was desired to commemorate. Steps were accordingly taken to ascertain whether there was in existence any house actually occupied by Boswell; and it has been discovered that he resided for some time at 56, Great Queen street. The committee now recommend that a memorial tablet should be affixed in Great Queen-street, and that the resolution with regard to Great Portland-street should be rescinded. In connection with this work of indicating houses of historic interest, the committee have had under consideration the question of the erection of a memorial tablet in memory of Sir Francis Chantrey. The only residence of Sir Francis Chantrey suitable for commemoration was 102, Buckingham Palace-road; but as that house has been recently demolished, the committee report that there is no residence of Sir Francis Chantrey's in London to which they can recommend that a memorial tablet should be affixed.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

DECEMBER 14.—"The Patent Laws." By CHAS. D. ABEL. ALEXANDER SIEMENS, Vice-President of the Society, will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

DECEMBER 20 (8 p.m.).—"Street Architecture." By THOMAS GRAHAM JACKSON, R.A. DR. G. B. LONGSTAFF, will preside.

Papers for Meetings after Christmas:—

"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By THE RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY.

"London Electric Railways." By the HON. ROBERT P. PORTER.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTAN.

"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height. Illustrated by voices, instruments and diagrams.

"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES.

"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN.

"Popular Jewelry." By MONSIEUR LALIQUE (Paris). (*Applied Art Section.*)

"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. (*Colonial Section.*)

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with musical illustrations).

LECTURE III.—DECEMBER 12.—*Reed Instruments.* —Single and double reeds—Conical and cylindrical tubes—Bagpipes—Shawms, oboes, and bassoons—Clarionets—Saxophones.

Programme of Musical Illustrations.—Oboe Solo, Concertino, *Guillhaut*, Mr. J. L. Fontayne.—Clarinet Solo, Concertino, *Weber*, Mr. Charles Draper.—Bassoon Solo, Adagio from Concerto, *Mozart*, Mr. E. F. James.—Trio, Oboe, Clarinet and Bassoon, *Huguenin.*—At the Pianoforte, Mr. R. H. Walthew.

JUVENILE LECTURES.

Wednesday afternoons, January 4 and 11, 1905, at Five o'clock, CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Two lectures.)

LECTURE I.—JANUARY 4.—A short history of the early days of illustrated newspapers—Preparations for illustrating events—How sketches are made—

Special war artists—Photography on the battlefield—The amateur photographer—Drawing from sketches Siege sketches by balloon post—Mafeking sketches by Colonel Baden-Powell—Production of process plates.

LECTURE II.—JANUARY 11. — Compositors at work—Preparation of stereos—Manufacture of paper—The printing office—Folding and stitching machines—Colour printing—Importance of good titles—The editor's waste-paper basket—Curious sketches: the Russian censor—Foreign illustrated newspapers.

The lectures will be fully illustrated by lantern slides. An exhibition of drawings will be shown on the walls.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. David James Blaikley, "Musical Wind Instruments." (Lecture III.—Reed Instruments, with Musical Illustrations.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Annual General Meeting.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. (Graduates Section) Mr. A. C. Hess, "Gas-Engine Testing."

Chemical Industry (London Section), Burlington-house, W., 8 p.m.

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Joseph Jopling, "Notes on Clay Working, more particular Bricks and Tiles."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major Delme Radcliffe, "The Anglo-German Boundary Expedition in East Africa."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. G. Clausen, "A Sketch of the Development of Painting."

TUESDAY, DEC. 13...Asiatic, 22, Albemarle-street, W., 3 p.m.

East India Association, Westminster Palace Hotel, S.W., 4 p.m. Sir W. Mackworth Young, "The Progress of the Punjab."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Messrs. Arthur Wood-Hill and Edward Davy Pain, "The Construction of a Concrete Railway Viaduct."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Hon. Walter Rothschild, "Some Notes on Anthropoid Apes." 2. Dr. W. G. Ridewood, "The Cranial Osteology of the Clupeoid Fishes." 3. Prof. E. A. Minchin, "The Characters and Synonymy of the British Species of *Leucosolenia*."

Colonial Inst., Whitehall-rooms, Whitehall-place, S.W., 4½ p.m. Lieut.-Colonel James Hayes-Sadler, "Present-Day Uganda."

Horticultural, Drill Hall, James-street, Victoria-street, S.W., 3 p.m. Mr. T. Sedgwick, "Fruit Preserving."

WEDNESDAY, DEC. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Chas. D. Abel, "The Patent Laws."

Biblical Archæology, 37, Great Russell-street, 4½ p.m.

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. V. H. Veley, "Hydrolysis of Ammonium Salts." 2. Mr. A. E. Dunstan, "The Viscosity of Liquid Mixtures." (Part II.) 3. Mr. J. A. Cain, "The Diazo-reaction in the Diphenyl Series." (Part II. "Ethoxybenzidine."). 4. Mr. P. C. Ray, "The Sulphate and the Phosphate of the Dimercurammonium Series." 5. Messrs. R. Meldola and L. Lynon, "A Method for the Direct Production of certain Aminoazo Compounds"

Japan Society, 20, Hanover-square, W., 8½ p.m. Dr. Vaughan Cornish, "Japanese Temples and Monasteries."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, DEC. 15...United Service Institution, Whitehall, S.W., 3 p.m. Mr. W. Kirton, "With the Japanese at the passage of the Yalu."

Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. T. W. Woodhead, "The Ecology of Woodland Plants." 2. Mr. C. C. Hurst, "Experimental Studies in Heredity in Rabbits."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. J. S. Shedlock, "Bird Music."

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. 1. Messrs. R. Arthur Thomas and W. P. O. Macqueen, "The Dust in the Air and the Gases from Explosives in a Cornish Mine (Dolcoath), and the efficacy of methods of dealing with them." 2. Mr. E. F. Harris, "The Permanganate Chlorination Process at Bethanga." 3. Mr. L. H. L. Huddart, "St. David's Gold Mine, N. Wales." 4. Messrs. B. H. Bennetts and L. J. W. Jones, "A New Slag Car."

Optical, 20, Hanover-square, W., 8 p.m. Mr. Brown, "Direct Stereoscopic Projection."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Searle's paper, "Studies in Magnetic Testing." Mr. W. P. Adams, "The Combination of Dust Destructors and Electricity Works, Economically Considered."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, DEC. 16...United Service Institution, Whitehall, S.W., 3 p.m.

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Students' Meeting. Mr. R. H. Lee Pennell, "Folkestone Harbour: Cylinder-Sinking at the Root of the Old Pier."

College of Physicians, Pall-mall East, S.W., 5 p.m.

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m. Mr. James Dickie, "Launch of the U.S.A. Cruiser, *South Dakota*."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Capt. H. Riall Sankey and Mr. J. Kent-Smith, "Heat Treatment Experiments with Chrome-Vanadium Steel." 2. Discussion on the November paper, "Impact Tests on the Wrought Steels of Commerce."

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FRIDAY, DECEMBER 16, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 19, 8 p.m. (Cantor Lecture.) D. J. BLAIKLEY, "Musical Wind Instruments." Lecture IV., (Flutes, with musical illustrations.)

TUESDAY, DECEMBER 20, 8 p.m. (Applied Art Section.) THOMAS GRAHAM JACKSON, R.A., "Street Architecture."

Further details of the Society's meetings will be found at the end of this number.

THE JOURNAL.

The members will have noticed that since the commencement of the present session the number of pages in the *Journal* devoted to miscellaneous matters has been slightly increased. It is intended, from the commencement of the New Year, to continue and to add to this enlargement.

The size of the *Journal* must, as hitherto, vary with the length of the Society's proceedings, which are published each week, but it is intended, as a rule, that the usual number of pages (including advertisements) should, in future, be 32 instead of 24, at all events during the session, and these additional pages will afford room for a larger amount of general information bearing on the objects of the Society.

The estimation in which the *Journal* is held, both by the members and the general public, is well-known, but if the members of the Society, especially those residing abroad, will assist by sending to the Secretary, information of a suitable character for publication, the Council believe that the value and interest of the *Journal* may be still further increased, and that it may be made even more useful to the members than it is.

The Council trust that they may rely on the active co-operation of the members in a matter so essential to the welfare of the Society.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 4th and 11th, at 5 o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

Mr. D. J. BLAIKLEY delivered the third lecture of his course on "Musical Wind Instruments," on Monday evening, 12th inst. The special subject was Reed Instruments, and musical illustrations were given on the Oboe by Mr. J. L. Fonteyne; on the Clarinet by Mr. Charles Draper, and on the Bassoon by Mr. E. F. James. Mr. R. H. Walthew accompanied the instruments on the pianoforte.

The first lecture of the course will be printed in the next number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FIFTH ORDINARY MEETING.

WEDNESDAY, DECEMBER 14th, 1904; ALEXANDER SIEMENS, M.Inst.C.E., Pres. Inst.E.E., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bayley-Worthington, A. B., 8, Balfour-place, Mount-street, W.

Deadman, Thomas W., 58, Northcote-road, St. Margaret's, Twickenham.

Forbes, David, 5, Benedict-road, Brixton, S.W.

Hatschek, Emil, A.M.I.Mech.E., 24, West Twenty-fifth-street, New York City, U.S.A.

Haynes, Josiah Edward, Union Offices Stroud and Paganhill, Stroud, Gloucestershire.

Kerr, Rennie Malcolm, Gokak Falls, Belgaum District, India.

McLaren, William David, A.M.I.Mech.E., Thomason Engineering College Workshops, Roorkee, India.

Mitchell, Arthur Edward, 10, Lower Mount Pleasant-avenue, Rathmines, Dublin.

Nicholls, Captain Alfred Edward, Cotswold, Hornchurch, Essex.

Reynolds, Major James M., Burdett, New York, U.S.A.

Weiskopf, Alois, 3, Sophienstrasse, Hanover, Germany.

Wharton, William Henry, L.R.C.P., 1, Brick dam, Georgetown, Demerara, British Guiana.

Wilson, George Lewis, 522, High-road, Tottenham, N.

The following candidates were balloted for and duly elected members of the Society:—

Chambers, John, Mokopeka, Hastings, Hawke Bay, New Zealand.

Hippisley, Clare Robert, 4, Belgrave-terrace, Bath.

Moorcroft, William, Marsh-avenue, Wolstanton, Staffs.

Owen-Jones, John, Shortmead-street, Biggleswade, Beds.

Peacock, James, 13, Fenchurch-avenue, E.C.

Sapara-Williams, Hon. C., M.L.C., Lagos, West Africa.

Smith, Thomas Strethill, 32, West-hill-road, Southfields, S.W.

Watkins, John, 48, Westbourne-street, Sloane-square, S.W.

Weston, Edward, 645, High-street, Newark, New Jersey, U.S.A.

The CHAIRMAN stated that owing to indisposition Mr. Abel was unfortunately unable to read his paper himself. It would therefore be read by Mr. Abel's partner, Mr. A. G. Bloxam.

THE PATENT LAWS.

By CHARLES DENTON ABEL.

Having regard to the fact that laws relating to the grant of letters patent for invention have now existed in England nearly three centuries, and in some of the other principal States for about 100 years, one would have thought that an experience extending over so large a time would have resulted in some degree of uniformity in the administration of hose laws in most countries, but, curiously to relate, so far from this being the case, there are at the present time no two of the principal States in which any substantial uniformity in this respect exists. There was, however, up to two years ago, a broad line of demarcation which divided the patent laws of the different States into two principal groups, namely, on the one hand, in countries such as England and France, the grant of letters patent was practically unconditional, being only subject to a supervision to insure the compliance of the applicants with certain prescribed rules and formalities, while, on the other hand, countries such as the United States and Germany subjected all applications for letters patent to a rigorous examination as to the novelty of the invention, and refused the grant to all those applications which, in the opinion of the Patent Office officials, did not contain a sufficiently novel invention. This being so, the question forces itself upon one's mind as to which of these diametrically opposite systems is the correct one, or whether they are not both defective in some respect? Now, in order to consider this question properly, it is necessary first to see what are the interests involved that should govern the mode of procedure, and here we find that they are of a two-fold nature; on the one hand, there is the interest of the inventor, who, having made what he considers a valuable invention, and having perhaps spent considerable time and money in practically working it out, naturally desires to reap an adequate pecuniary benefit therefrom by means of patent protection; on the other hand, there are the interests of the community or of the State, which is willing to pay a certain price in order that its industries may benefit by the use of a really good and novel invention, but does not want to pay that price for an invention that is not new. From this consideration, it will be apparent that the indiscriminate grant of patents for inventions is against the interests of the State, and that if there really existed some perfectly reliable and equitable way of determining whether an invention is novel and useful or not, the system of examination in this respect, and of making the grant of a patent dependent upon the proof of novelty, would be the correct one, as an inventor cannot reasonably expect to be put in a position to derive pecuniary benefit by the grant of a patent for an invention which was made by others before him.

But unfortunately there is no perfect system in existence, and in my opinion there never will be. In all the States where this system

of deciding upon the patent ability of an invention is carried out, the practice is full of errors and anomalies; patents are there still granted for inventions that are old, and patents are refused for inventions that are new and valuable, thereby both doing great injustice to the inventor, and also detrimentally affecting the interests of manufacturing industries, inasmuch as an inventor who is refused protection for his invention has no incentive to devote his time and capital to perfecting it and getting it taken up, and the invention may thus be lost to the industry to which it belongs.

Now these defects in the system are mainly due to two causes, namely, firstly, to the fact that power is given to a single examiner, who may or may not be properly qualified, to refuse an application for a patent upon such grounds as he may think fit, and secondly, to the fact that, owing to a system of false economy, the examining staff appointed to do the work is totally inadequate for the purpose, so that an examiner is required in the space of a few hours, firstly, to instruct himself as to the nature and merits of an invention, and then to search in order to ascertain its novelty, with the result that owing to the want of proper time for deliberation, his decisions are as often wrong as they are right, and that he frequently totally misconceives the gist of the invention to begin with. As a proof of the above assertion, I need only point to the fact that both in the United States and in Germany cases are continually occurring where the primary examiner's decisions refusing the grant of a patent are reversed on appeal, a fact which I believe every patent agent in even moderate practice can confirm. It may, of course, be argued that as there exists this safeguard of appeal, there is no great harm done by the primary examiner's rejection. and if every inventor were a man of means, and in a position to employ a competent professional adviser in prosecuting his application for a patent that might be so. But, unfortunately, a very large proportion of inventors are not men of means, and, in consequence, not being able to afford the fees of a competent professional adviser, they either prosecute their applications themselves or employ some unqualified person for the purpose. As a result, when the primary examiner refuses the application of such an applicant, the latter may either believe the fallacious arguments of the examiner, and, consequently, abandon his application, or he may be prevented by lack of funds from going to the expense of an appeal.

In order to show that my statements as to the detrimental effects of the United States and German systems are not imaginary, I will first refer to a case that has lately occurred in the practice of my firm in respect of an invention of some importance, which, being about to be introduced on a large scale, may possibly interest my hearers. In the year 1901, Messrs. Vogt and von Recklinghausen applied for a United States patent for a method of and apparatus for producing motive power by causing an explosive charge to force a body of water into a chamber where it was stored at high pressure, and whence it was taken for working hydraulic motors. In order that the proceedings before the United States examiner may be thoroughly understood, I will describe broadly the construction and action of the machine for this purpose, referring to the diagram on the wall. In this diagram, which only shows the main operative parts of the machine, there is a cylindrical compression and explosion chamber, the lower end of which is surrounded by an annular chamber, wherein water is stored at a comparatively low pressure, the pressure being exerted by a cushion of compressed air in the upper part of the chamber. This low pressure chamber is adapted to communicate with the first chamber through openings which are, however, normally closed by means of a piston having passages through it controlled by a self-acting lift valve. Above this second chamber is another annular chamber which is adapted to communicate with chamber 1 through openings which are normally closed by a self-acting lift valve. This chamber 3 contains water subjected to a high degree of pressure by a cushion of compressed air at top. The chamber has an inlet for explosive charges, a discharge valve for the combustion gases and an air supply valve. The three chambers being filled with water to about the extent shown, the action of the machine is as follows: Assuming the upper part of chamber 1 to have been filled with air through the valve an explosive charge is admitted through a nozzle controlled by a suitable valve. Hereupon the piston is raised by mechanism, not shown, sufficiently to uncover the openings, so that the water contained in chamber 2 is forced through the said openings, and through the valve of the piston into the chamber 1, thereby forcing up the column of water therein and thus com-

pressing the explosive charge. This is then fired, and the resulting explosion drives the column of water through the openings into chamber 3, thus compressing the air-cushion to a greater extent and consequently subjecting the water to a higher degree of pressure. The water in chamber 1 having thus again sunk to about the level indicated, the escape valve and air valve are both opened and a scavenger blast of air is made to drive the combustion gases off. On the occurrence of the explosion, the piston and valve are forced down into their original position, shutting off the communication between 1 and 2. The water under high pressure stored by the above action in chamber 3 is led off through a pipe to any suitable hydraulic motor, the discharge from which, still under a certain pressure, is led back through a pipe into chamber 2 to replenish its store. The piston being again raised, the above-described action is repeated, and so on continuously. It will thus be seen that apart from the construction of the machine there is a two-fold action of the liquid, first in being forced up in chamber 1 so as to compress the explosive charge, and, second, in being forced by the explosion into the chamber 3. In the claims originally made in the specification of the United States application, the above-described action of the liquid was referred to in setting forth the construction of the machine. These claims were, however, objected to by the examiner as being "functional," under a peculiar rule of the United States Patent Office, which I have formerly explained in my letter in the Society of Arts *Journal*, July 29th, 1904. Separate claims for the method of operating were then drafted and submitted to the examiner, who, under another peculiar rule of the office (which has since been declared *ultra vires* by the Supreme Court in the case of Steinmetz *v.* Allen 1090 G 549, of which particulars are given in Appendix No. 4) refused to allow these claims to be included in the same patent with the claims for the apparatus, in consequence of which the inventors, acting under my advice, filed a separate application for the method of operating, in which the claims required to be so worded as to avoid all mention of the apparatus (in compliance with another peculiar rule of the office) as the following claim, which I quote by way of example, will show:—

"That improvement in the art of producing liquid under pressure which consists in providing a body of liquid under a head for performing work, and a second body of liquid under a lower head, which is made to compress an explosive charge, and causing the explosion of such charge to act upon a portion of the liquid of lower head and cause it to replenish the liquid under the higher head, substantially as described."

After various communications had passed between the examiner and my firm's representative at Washington upon the question as to whether there was a patentable method involved in this new application or not, the examiner finally refused to allow the patent, stating, "It is still thought, particularly in view of the Supreme Court decision in Busch *v.* Jones, that the alleged method presented by the claims is the mode of operation of the apparatus employed." My clients then appealed against this decision before the Board of Examiners in Chief, with the result that the examiner's decision was reversed and the patent was granted. As the Examiners in Chief's ruling on the question of the method claims being patentable or not is of considerable interest to inventors and patentees generally, I have given it in full in Appendix No. 1, as it would take too long to quote it here; I will only give here the first sentence as showing how emphatically they declared the primary examiner to be in the wrong:—

"As to the ground of rejection on the alleged absence of true method claims, the validity of these claims as true process claims under the decision of the Courts is too plain to admit of discussion."

It will be seen, from what I have stated, that in the first instance, the examiner obliged my clients to take out two patents instead of one, thus causing them double expense, and this on account of a rule of the Patent Office which, as before stated, has since been declared *ultra vires*; secondly, in denying the existence of a patentable method he put them to the additional expense of appealing against his decision.

Had my clients been of limited means, or had they been badly advised, they would probably have accepted the examiner's decision as final, and would thus have lost the most valuable part of their invention, because the apparatus for carrying out the method of operating could be constructed in various other ways than that which was covered by their second patent.

Many cases similar to the above could be quoted, both before the United States and the German Patent Offices, where the adverse decision of the examiner has been reversed on appeal, but it would lead too far to go

into these here. In Appendix 2, I have given a further case before a United States examiner, and in Appendix 3, I have given a case before a German examiner, in which he rejected an application simply because he quite misunderstood the purport of the claims. A further instance of the prejudicial effect that the action of a United States examiner may have upon the interests of an inventor, will be found in Appendix 4, which gives an abstract of the judgment of the United States Supreme Court in the important case of Steinmetz *v.* Allen, from which it will be seen that it took the petitioner *over seven years* to vindicate his rights, owing to the improper decision of the examiner, in refusing to allow him to appeal from the examiner's decision to the Board of Examiners in Chief.

How seriously the above system of examination, as carried out in Germany, operates against the interests of the inventor will be evident on considering the above Table, published by the German Patent Office, showing the number of patent applications and number of patents granted during the years 1901, 1902, 1903, particularising the applications made by the German inventors, and those of the inventors of all the other States. It will be seen from this Table, that the total average percentage of patents granted is only 38·5 per cent. of the applications, while for Germany alone the average only amounts to 34·2 per cent. (in 1903 it was only 30·9 per cent.), in other words, it shows that out of every three applications for a patent practically two are refused. It will also be seen from this Table that, with the exception of one or two minor States the proportion of rejections have gradually increased from 1901 to 1903—in the case of Germany from 63 per cent. to 70 per cent.

No one who has had much to do with patents for inventions would be prepared to say that the proportion of old inventions to new ones is anything like so large as this. From my own experience, extending over about 45 years, I should put the proportion in cases that have come before me, roughly at about one old invention to five or six new ones. Unfortunately no such Table as the above is published in the United States reports, but the latter give the number of applications for patents in the year 1903 at 49,289 and the number of patents granted at 31,046; that is to say 63 per cent. of the applications, or approximately double the percentage granted in Germany. Referring again to the Table, it may be as well to point out that this entirely dispels the erroneous idea entertained by many English patentees, that great favouritism is shewn in the German Patent Office to German inventors to the detriment of foreign inventors. It will be seen that the average percentage of patents granted to German applicants is only 34·2, while the percentage granted to United States applicants is 59·4, and the percentage of patents granted to English applicants is 54·1, so that as a matter of fact, the German inventors come much worse off than the foreigners.

I think that on considering the facts which I have given it will be generally conceded that

Patents Applied for and Granted in Germany, 1901-2-3.

	Year.	German Applicants.	Applications by Subjects of Foreign Countries.											Total Foreign Countries.	Total Foreign Countries and Germany.
			Belgium.	Denmark.	France.	Great Britain.	Italy.	Austria-Hungary.	Russia.	Sweden and Norway.	Switzerland.	U.S. America.	Other States.		
Applications	1901	17,622	301	258	1,234	1,331	177	1,110	292	278	424	1.752	386	7,543	25,165
Patents Granted	1901	6,609	123	84	633	727	69	506	123	147	230	1,094	163	3,899	10,508
Applications	1902	19,646	383	225	1,451	1,332	147	1,110	287	306	481	1,805	412	7,919	27,565
Patents Granted	1902	6,697	135	100	504	742	68	522	123	138	220	1,097	174	3.913	10,610
Applications	1903	20,521	336	228	1,235	1,281	172	1,057	334	221	515	1,947	466	7,792	28,313
Patents Granted	1903	6,334	102	81	581	665	63	425	121	137	225	1,069	161	3,630	9,964
Percentages of Grants in 100 Applications.	1901	37·5	40·9	32·6	51·3	54·6	39·0	45·6	42·1	52·9	54·2	62·4	42·2	51·7	41·8
	1902	34·1	37·2	44·4	40·9	55·7	46·3	47·0	42·9	45·1	45·7	60·8	42·2	49·4	38·5
	1903	30·9	30·4	35·5	47·0	51·9	36·6	40·2	36·2	60·0	43·7	54·9	34·5	46·6	35·2
Average for 3 years	1901-3	34·2	36·2	37·5	46·4	54·1	40·6	44·3	40·4	53·3	47·9	59·4	39·7	49·2	38·5

my assertion that the system of examination as carried out by the United States and Germany is highly prejudicial to the inventor, is perfectly justified, and this being so, the question arises, is it not possible to devise some system intermediate between that of the indiscriminate grant of patents, and this very objectionable one, that would fairly satisfy the interests of the inventor and those of the community?

Now, fortunately, such a system *can* be devised, and was in fact proposed by me some forty years ago, and it is a matter of wonder to me why it was not until the year 1901 that our Government could be persuaded to take it into consideration and finally embody it in the Patents Act of 1902. This system, which is to be put in force by the Patent Office on the 1st January, 1905, consists shortly in this, that on an applicant lodging a complete specification at the Patent Office, a full and careful search shall be made by the examining staff among all patents taken out within the last fifty years, in order to ascertain whether the invention claimed is really new. If a prior patent should be found which, in the opinion of the Comptroller-General, more or less anticipates the invention, the applicant is to be apprised of this, and it is open to him either to amend his specification if he is convinced of the correctness of the assertion, or to argue against the Comptroller's opinion. If after hearing his arguments the Comptroller is still of opinion that the applicant is anticipated by the prior patent, he has the power, subject to an appeal to the Law Officer, to cause a reference to be inserted in the specification to the prior patent or patents in question. Thus any intending licensee under or purchaser of the patent is at once made aware of the alleged anticipation, and is put in a position to decide for himself what may be the value of the patent in the face of the prior publication.

I think it will be agreed that this system is a perfectly equitable one, as it still leaves the inventor perfectly free to take out his patent for whatever it may be worth, while, at the same time, it prevents him from imposing upon the public with a bogus patent. As long ago as the year 1855, in a paper that I read before the Society of Engineers, I very strongly advocated this system and, among other arguments, I stated as follows, in referring to the question of the novelty of inventions:—

"Of this, and of the other points, a duly qualified Board of Examiners would be quite competent to judge; they should, however, only have the power of absolutely refusing applications, the alleged inventions of what were based upon assumptions obviously at variance with known physical or mechanical laws, while in all other cases where their opinion differed from that of the inventor, the matter should be referred to a patent tribunal to which the inventor should, under any circumstances, have the power of appealing; and if the opinion of the examiners were endorsed by this tribunal, it should be appended to the specification of the patent."

It will be seen that the mode of procedure now adopted is based exactly upon these lines. The important question now arises, however, as to the manner in which the system is going to be carried out so as to be perfectly just to the inventor. This practically resolves itself into a question as to the amount of money that is to be spent for this purpose, that is to say, it depends on the one hand upon whether a perfect system of classification of inventions is to be provided, which will enable the examiners to ascertain in the shortest possible space of time all prior patents that may bear upon the invention of an applicant, and, on the other hand, it depends upon the number and quality of the examining staff that is to be employed upon this work. If money is to be stinted on either of these heads, then it would be far better to abandon the system altogether. Now both in the United States and in Germany, a system of parsimony prevails in this respect. It is true that in the United States a fairly perfect system of classification of inventions has been worked out, but as regards the examining staff the number of men engaged on the work is ludicrously inadequate, and this remark applies equally to the German Patent Office, as will be shown from the following data. Referring in the first place to Germany, there were in the year 1903, 28,313 applications for patents which had to be dealt with by an examining staff numbering 217. This gives as the work of each individual examiner an average of 130 applications to be dealt with in the year. As I am informed that there are about 1,940 official working hours in the year in Germany, this will give an average time of about 15 hours, during which the examiner must completely deal with one invention; that is to say, he must first thoroughly study the invention, he must then make a complete search as to novelty, and must argue the case at length with the applicant, involving in many cases a long correspondence and reconsideration of amended specification, claims and drawings, before he can come to a final decision respecting the application. All this

would have to be accomplished in the before-mentioned average time of 15 hours, a task which anyone acquainted with this class of work will admit to be a perfectly impossible one. In the United States the case is still worse; here, there were in 1903 no fewer than 49,289 applications for patents that had to be dealt with by an examining staff numbering 261, giving roughly 190 applications to be dealt with by one examiner in the year. The number of official working hours in the United States is about 1,911, thus giving an average time of ten hours for an examiner to deal with one application. Now the result of this very inadequate time allowance is, that the examiners do not, and simply cannot, efficiently do the work that is supposed to be carried out by them.

The applicant's invention is not carefully studied by them, and, as a consequence, is frequently entirely misunderstood; also, instead of making a careful search, and only drawing the applicant's attention to those prior patents that really more or less anticipate his invention, they simply pick out all patents that deal with the class of invention in question, and practically say to the applicant, "All these, in my opinion, anticipate your invention, prove to me that they do not." The unfortunate applicant then has to wade through perhaps a dozen or more specifications in order, possibly, to find that the majority thereof in no way relate to his invention at all, and that this is not anticipated by any one of them.

I am sure that anyone who has had to deal to a considerable extent with the United States and German Patent Offices, will bear me out in this statement. In order to give some idea of the inadequacy of the United States and German examining staffs for tho work they have to perform, I have requested one of the searchers employed by my firm to ascertain the average time occupied in effecting a search as to the novelty of an invention, for which purpose he has taken all searches made by him between June, 1903, and June, 1904. There were in all 31 searches which occupied altogether 2,440 hours, giving an average of 80 hours for each search. In comparing this time with the figures before stated, however, it is necessary to take the following points into consideration. Firstly, the searcher happened to have no searches of very short duration during that year, which would have reduced the average, the shortest one occupying 21 hours, and secondly, the patent office indexes and illustrated abridgments were the only means available to the searcher, while the official examiner would have his specially prepared detailed classifications of inventions to help him. Taking these points into account, I would be willing to put the average time of an examination and search, to be properly carried out by the Patent Office examiner, at a much lower figure than my searcher's average, say about 30 hours as compared with 15 hours and 10 hours now allowed respectively by Germany and the United States.

If my estimate is correct, then it would appear that the German staff should be at least doubled, and the United States staff trebled; I say "at least" because it should be stated that the work of the searcher in question would end with reporting to his employers the number of prior English patents relating to the invention found by him, and would not include the considerable additional work of searching among foreign patents and other publications. of carefully examining the patents and publications found, and subsequently reporting thereon, which the foreign official examiners have to do.

I now come to the important question as to what our Patent Office proposes to do when starting upon the new system. I am informed that the Comptroller-General proposes to start with an examining staff consisting of 24 chief examiners, 24 deputy examiners, and 131 assistant examiners, making a total of 179 examiners.

Taking the number of complete specifications to be examined in one year at 15,821, that being the number filed in 1903, this will give 88 specifications to be dealt with in one year by each examiner. Assuming the number of official working hours to be 1,430, that being the number given by the Comptroller-General in the official report of 1901, this would give 16 hours as the total time an examiner could devote to one application.

The next Table shows the above quoted data for the United States, Germany, and England, from which it will be seen that with the proposed staff of 179 examiners the system would be no more perfect than it is in Germany. It may be that the Comptroller-General only proposes this number to begin with and intends to increase it gradually as the work increases, and this would be right enough, because of course the full number of applications to be examined would only be reached at the end of the first year. I fear, however, that this is not

his intention, because in the report of 1901, when speaking of the results of the trial search which the Comptroller had had made, he gives it as his opinion that one examiner could deal with 111 applications in the year, which would give an average of only 13 hours for each case.

In considering this point it is to be observed that the work of examination in respect of English patent applications will be much heavier than either in the United States or Germany, for the following reasons :—

Applications for English patents contain as a rule a very much greater amount of subject-matter than is the case with United States and German applications, because, as is well known, the idea of what constitutes one invention is very much more limited in those States than in Great Britain. This is proved by the fact, that when United States inventions are sent over here to be patented, it is quite a common occurrence for the subject-matter of several of these to be included in one English patent. This was the case, for example, with a series of patents relating to mechanical cashiers, which I had under consideration some time since, one of which, No. 2130 of 1902, contained the subject-matter of four United States patents, and consisted of 21 pages of text, and 23 sheets of drawings. The apparatus described simply bristles with minute and complicated details, all of which were claimed and would have to be separately searched for by the examiner. How long it would take an examiner to deal properly with this specification, I should be afraid to say. This is by no means an exceptional case, a large number of similar patents, mostly of American origin, being taken out every year; to give another example, there is a patent, No. 2302 of 1902, on the subject of golf balls, which includes the subject-matter of no fewer than *nine* United States patents and contains 51 claims.

Thus, it will be seen that the English examiner who had to deal with this patent would have to do the same amount of work as the United States examiner expended on the examination of nine United States patents.

Here I may, parenthetically, draw attention to another example of the old story of English liberality in dealing with subjects of foreign States and the illiberality of those States in dealing with English subjects. While our Patent Office allows any number of United States or German patents to be combined in one English one, the Patent Offices of those not only do not allow this, but, owing to their peculiar views as to what constitutes one invention, they actually require a large proportion of English specifications to be divided up into a number of separate applications; thus, for example, my firm was obliged to divide the subject-matter of the English Patent No. 15286 of 1885 for the well known Welsbach incandescent light, into five United States applications, while another patent on the same subject, No. 3592 of 1886, had to be divided into four United States patents. Again an English patent for a typewriting machine had to be divided into five German patents, even after abandoning several of the improvements, thus involving the patentees in an expenditure of £1,312 10s. for keeping up these patents as compared with the cost of £99 for the British patent. It is a question, therefore, whether something should not be done in the way of retaliation, by our Patent Office refusing to allow more than one foreign patent to be included in one British patent.

In the new rules lately issued by the Board of Trade, some general provision has been made in this direction by the statement that

TABLE SHOWING THE AVERAGE TIME ALLOWED AN OFFICIAL EXAMINER FOR SEARCHING AS TO AND DETERMINING THE NOVELTY OF AN INVENTION.

Country.	Number of applications to be examined in 1903.	Number of examining staff.	Number of applications to be examined by one examiner in one year.	Official working hours in a year.	Average time afforded an examiner for dealing with one application.
United States	49,289	261 (*a*)	190	1,911	10 hours.
Germany................	28,313	217 (*b*)	130	1,940	15 hours.
Great Britain............	15,821	179 (*c*)	88	1,430	16 hours.

(*a*) Composed of 38 Chief Examiners, 42 First Assistant Examiners, 50 Second-class, 61 Third-class, 70 Fourth-class.
(*b*) Composed of 86 Chief Examiners, 131 Assistant Examiners.
(*c*) Composed of 24 Chief Examiners, 24 Deputy Examiners, and 131 Assistant Examiners.

"when a specification comprises several distinct matters, they shall not be deemed to constitute one invention by reason only that they are all applicable to or may form parts of an existing machine, apparatus or process," which rule, however, will of course apply not only to such cases as I have mentioned, but of view. Thus, on the one hand, in the United States a patentee is allowed to include in one patent several separate improvements on one and the same machine, but if an invention is capable of being carried out in variously modified ways and it is necessary to claim each of those modifications separately in order

Table Shewing the Divergent Views of the U.S.A. and German Patent Offices in the matter of Patentable Inventions.

	What constitutes a patentable invention.	*What is allowed to be included in a patent as one invention.*	*What form the claims are required to take.*
United States.	Any combination of devices that is substantially new is patentable. Such new combinations need not necessarily possess any particular technical advantage over similar-known combinations.	Several improvements relating to the same machine may be included, although they may not be dependent upon each other. Modification of an invention, if required to be claimed separately, have to form the subject of separate patents.	Claims for apparatus or machinery may consist o' a mere enumeration of the parts constituting a new combination without any statement of their relation to each other. Claims of a "functional" nature, *i.e.*, setting forth the operation, effected by the several parts of a machine enumerated are not allowed.
Germany.	A new combination of devices, no matter how different from known combinations for the same purpose, is not considered a patentable invention, unless it can be shewn that a substantially new technical advantage is derived therefrom. A very small modification of a known device, method or process, can constitute a patentable invention, provided it is shewn that a substantially new technical advantage is derived therefrom.	Several improvements relating to the same machine cannot be included in one patent unless they are necessarily dependent upon each other in their functions. In a patent for a substantially new machine, apparatus, or process, there may be included separate claims for modifications thereof.	Claims merely setting forth a combination of devices, without any statement as to how they operate, are not allowed. Claims are required to be of a "functional" nature, *i.e.*, they must set forth the operation of the parts enumerated.

generally to all patent applications, and the difficult question will arise as to the proper definition to be put upon the term "one invention." As I have before mentioned both the United States and the German Patent Offices have put a very strict interpretation upon this term, but, curiously enough, the rules in this respect are based upon totally different points to properly secure them, the Patent Office looks upon each such modification as a separate invention and consequently the inventor is obliged to take out a separate patent for each one.

In Germany, on the other hand, the applicant is allowed to include several modifications of an invention in one and the same

patent, but if the invention relates to several improvements in one and the same machine, which improvements have no direct relation to each other, then the German Patent Office says, that each of these improvements is a separate invention, requiring a separate patent. The German and United States Patent Offices are equally divergent in their views upon all other questions relating to patents, and by way of curiosity I have exemplified this on the preceding Table.

As an example of the lengths to which the German Patent Office will go, in subdividing inventions, I cited a case in my letter in the Society of Arts *Journal* of the 26th February, 1904, in which my clients were required to take out two separate patents for improvements in connection with one and the same lever device, because an improvement relating to means for connecting the one end thereof was not necessarily applicable in combination with another improvement relating to its fulcrum. Our Patent Office has hitherto taken a view which is equally divergent from both the United States and the German views on this question of one invention. The Comptroller has allowed a number of different improvements in one machine, and also several modifications of the same to be included in one patent, but when a certain improvement was claimed to be applicable to another class of machine, he has held that this was a separate invention requiring a separate patent.

From the paragraph which I have before quoted from the new rules, it would appear that the Comptroller is now going to adopt a definition similar to the German one, but let us hope that he is not going quite so far in this direction as in the instance which I have cited.

As I have before stated, the efficient carrying out of the new system depends probably quite as much upon a proper classification of the inventions as upon the number and quality of the examining staff.

The search as to the novelty of an invention is obviously enormously facilitated, if one has close at hand a complete synopsis of all prior patents in any way relating to the invention in question.

Now the most perfect system of classification in existence is probably that carried out by the United States Patent Office.

In this office, the subjects of invention are divided into 235 classes, and these classes are distributed among 38 examining divisions of the office. The plan according to which the different subjects are distributed among many of these divisions is somewhat perplexing, for example to division 5, we find allocated book-binding, fine arts, harvesters, jewellery, and music, and it is somewhat difficult to see how the examiner in charge of this division can be thoroughly at home in such diverse subjects as book-binding, harvesters, and music. Again, in division 25 we find such heterogeneous subjects as artesian and oil wells, butchering, mills, stoneworking, threshing, and vegetable cutters and crushers.

Furthermore, seeing that all other subjects relating to agriculture are included in division 1, it is difficult to understand why harvesters are put in division 5, and threshing-machines in division 25.

Division 20 again includes the various subjects of artificial limbs, builders' hardware, dentistry, locks and latches, safes and undertaking. However, it may be supposed that the chief examiner in charge of the division has under him assistant examiners, each of whom is more particularly conversant with one or more of the classes of the inventions in that division that are of a cognate nature. The several classes enumerated in each division are again divided into a large number of sub-classes, which, for example, in class 144, relating to wood-working, amount to over 300, each of which sub-classes relates to some special detail of a particular kind of wood-working instrument. Thus, for example, if the subject-matter of an application relates to a special kind of boring tool, the examiner finds to his hand no less than 21 classifications of tools or devices that come under this heading, and he can at once put his hand upon all the patents that relate to a boring tool of the nature of the invention in question.

But however complete this system of classification may be, it still does not, in my opinion, go far enough. There are a considerable number of inventions patented every year that include new or improved devices which are applicable generally to a great variety of machines or apparatus, and that may be termed "machine elements;" such for example as valves, levers, cranks, eccentrics, differential motions, stuffing boxes and other packings, &c., and these are frequently hidden away in machines or apparatus where one would scarcely expect to find them. Thus, I had before me a short time ago an invention relating to a flying machine, part of which consisted in a very novel and ingenious construc-

tion of sun and planet mechanism that might be applicable to a number of other purposes; also an invention relating to machinery for the manufacture of boot-lasts, which contained a novel construction of regulating valve for the hydraulic actuating mechanism, which was covered by a substantive claim. Now, there is provided in the United States classification a class No. 74 for machine elements which is allocated to division 12, and any patent that relates solely to a certain machine element would be referred to that division and class, in which, however, I may remark there is not included a sub-division for either valves, pistons, or a number of other common elements; the above-mentioned last-making machine, however, would be allocated to division 29, class 145, for wood-working apparatus and the examiner of that class on searching, and not finding, a prior patent anticipating the subject-matter of the claims, would report to that effect, and the patent would be granted in due course, although there might possibly exist a prior patent relating to an entirely different class of machine which contained exactly the same construction of valve as in the patent mentioned, and the publication of which would consequently invalidate the substantive claim for the valve made in the last-machine patent.

In order to remedy this imperfection, I would propose the following. A separate class should be established not merely generally for machine elements, but for every separate machine element, such as those I have before referred to, and the specification of every patent relating to machinery should be carefully analysed to see if it contained any new or improved machine element, and in the event of there being such, it or they should be entered into the corresponding class or classes.

Every division of the examining staff should then be supplied with a set of these classes for machine elements, so that, for example, the examiner in the before-mentioned class 145 for wood-working apparatus, after having examined all patents relating to last-making machinery, would then have to refer to the particular class for valves, in order to ascertain the novelty of the construction of the valve in question.

Now, no doubt the carrying out of such an elaborate analysis of all patents—and the before-mentioned required great increase in the examining staff—would entail a very considerably increased expenditure in the Patent Office, to which our Government would no doubt object, but I say that in view of the great advantages that would be derived therefrom, both by inventors and the public generally, that increased expenditure ought to be insisted upon. There has, in fact, been a great deal too much false economy practised heretofore by the Government in respect of the Patent Office, and this from the simple fact that neither the Government nor the public has ever estimated at its true value the great debt this country owes to inventors and their inventions. The British public accepts, as a matter of course, every new invention that is brought before it. It knows nothing of the toil, the expenditure of capital, the hard brain work to which inventors subject themselves in order to bring those inventions to perfection, and, consequently, it does not feel particularly grateful to them.

We delight to honour our great statesmen and warriors, even to the extent of decorating their statues annually, but who dreams of doing honour to our great inventors? Yet where would the former be without the latter? Where, I ask, would be the present widespread state of mental culture but for the invention of paper and the printing press? Where our great maritime commerce and our magnificent colonial possessions across the seas had it not been for the invention of the mariner's compass? Where, again, would be our great manufacturing industries and the commercial prosperity arising therefrom, but for the inventions of men such as Watt, Crompton, Arkwright, Stephenson, Huntsman, Whitworth, Fairbairn, Bramah, Bessemer, Siemens, and a host of others? Here, no doubt, many will say: Granted that these men deserve well of the nation, but they had their reward in the fortunes they made out of their patent rights.

No doubt some of them did so, but also many of them certainly did not; it is a well-known fact that many notable inventors died in poverty, and that it was only the manufacturers, who afterwards adopted their inventions, who made money by them. And even of those inventors who eventually did reap pecuniary benefit from their inventions, many, in their enthusiastic belief in their inventions, had spent almost their last penny in costly experiments before they attained success.

It is well-known that the late Sir Henry Bessemer spent nearly the whole of his capital upon his invention before he was rewarded with success. Again, the late Sir William Siemens himself told me that he had spent

over £10,000 upon his regenerative furnace invention before it was commercially successful.

Thus, it is as much the indomitable courage and perseverance of these inventors, as their inventive genius, that should command our admiration and gratitude.

If then we owe so much to inventors, without adequately recognising their merits, let us at any rate do full honour to an institution that may well be considered as the representative of their genius and labours. Let us make the Patent Office as perfect a technical institution as it is possible to be, thoroughly equipped in every respect for carrying out the duties it has to perform.

The German Empire, with its comparatively limited finances, is now spending nearly a million sterling upon a new patent office of palatial proportions; if we are content to forego such magnificence, let us at any rate not grudge a few thousands for perfecting the administration of our Patent Office. At the present day, considerably over £100,000 surplus income derived from the pockets of inventors flows annually from the Patent Office into the coffers of the Treasury. Every penny of this money and as much more as may be required should be expended in carrying out the most perfect system imaginable for enabling full justice to be done to the interests of inventors and the manufacturing community; and be it said that the Patent Office might advantageously take upon itself functions going far beyond the mere work of carrying out the Patent Laws. In this respect I will venture to quote another paragraph from the above-mentioned paper which I read before the Society of Engineers in 1865. After pointing out how, in my opinion, the work of indexing and classification as it was then carried out by the Patent Office should be improved, I went on to say—

"But besides completing and perfecting the information at present afforded by the Patent Office, its functions as technical guide and purveyor of useful knowledge to the inventor and to the public generally, might, with advantage, be greatly extended. The Patent Office should constitute a perfect technical encyclopædia. The inventor should then be able to obtain a complete knowledge not only of patented inventions, but of all and everything appertaining to arts, science, and manufacture that exists.

"No pains should be spared, no expense shunned, to procure, to sift, to classify the required information, and to put it in the hands of the inventor in such a form that he could readily make use of it. The proper fulfilment of such a task would be a noble object for the Patent Office, and would raise it to the level of one of the first institutions of the land. . . .

"A staff of competent officials should be appended to the Patent Office, whose duty it would be to travel about, both at home and abroad, and collect all such common knowledge, forwarding it to the Patent Office to be there digested and classified and put in a useful form before the public."

To those who would smile at the idea of going to the expense of sending a roving commission to other countries for the purpose of picking up useful information, I will only say that *this is precisely what the Germans did more than* 50 *years ago.* When I was a student at the then most important German Government Engineering and Technical College at Carlsruhe in Baden, during the years 1848-52, there already existed in the college portfolios upon portfolios of large scale drawings obtained by this means of English railway plant, detailed drawings of English locomotives and drawings of machinery obtained, goodness knows how, from some of our largest engineering establishments. The trouble thus taken by the Germans in those early days to afford the youth of the country a thoroughly scientific and technical education, has stood them in good stead, and quite explains the marvellous advance of German engineering and technical industry, which has now become such a formidable rival to England. We, on the other hand, in our insular pride and self-sufficiency, have all along scorned to take the trouble of ascertaining what was doing in scientific and technical matters in other countries, and as a consequence we have now been left behind in the race.

There yet remains another important point to be considered in connection with the new system of examination, namely, the question as to what will be the best course to pursue in carrying out the Act of 1902 for "giving notice to the public of any prior patents that in the opinion of the Comptroller-General more or less anticipated the invention," in those cases where the applicant refuses to refer to them in his specification.

Three modes of carrying out the said provision present themselves to one's mind; the simplest and most obvious would of course be, for the Comptroller merely to add a memorandum to the specification stating that such and such prior patents should be referred to when considering the particular invention; the second would be for the Comptroller to add to this statement his opinion as to how the said

patents affect the invention in question; and the third would be for the Comptroller merely to refer the public to the record of the proceedings in the matter before the examiner and the Comptroller. Now, according to the new rules, the Comptroller proposes to proceed according to the first system, and this would, in my opinion, be objectionable, because it might operate very prejudicially to the interests of the patentee, inasmuch as anyone contemplating taking an interest in the patent in examining the specification, and seeing possibly a long array of prior patents quoted against it, would in most cases be at once prejudiced against the patent, and decline to have anything to do with it.

The second system would be less prejudicial to the patentee, but to be equitable, it might entail a very long statement on the part of the Comptroller, and therefore cause a considerable expenditure of official time that could ill be afforded. The third system, which is similar to that proposed in a paper read by me before the International Association for the Protection of Industrial Property, is, in my opinion, the most practical and most equitable to the patentee. According to this, the complete record of the proceedings before the examiner and the Comptroller should be open to the public, who, on application should be able to obtain a copy thereof, as is the case in the United States Patent Office, where the system is very largely availed of, not only in connection with United States patents, but also in connection with the corresponding English patents, for the purpose of ascertaining whether the validity of the latter is in any way affected by what was disclosed by the United States Record. This information would put anyone interested in full possession of all the arguments both for and against the validity of the patent, so that he or his professional adviser could draw their own conclusion on this point.

Whether the Comptroller-General is at liberty to pursue this course in view of the wording of the Act which says that the Comptroller "shall . . . . determine whether reference to any, and if so, what prior specifications ought to be made in the specification," may be an open question, but it seems to me that if he referred to the record which sets forth the specifications in question this would amount to a reference to those specifications in compliance with the above clause.

A last remark I have to make refers to Section 7 of the new rules. This section provides that as soon as an examiner on commencing his search, finds that the invention has been wholly claimed or described in a prior patent, he shall at once make a provisional report to the Comptroller without proceeding further with the search, and if the Comptroller finds the examiner's opinion to be correct, the application shall be dealt with as provided by sub-section 6 of the Act of 1902; that is to say, the Comptroller may at once make a reference in the specification to the anticipating patent found. Now it may happen that if the examiner had continued his search to the end, he might have found one or more other patents that anticipated the invention more completely and indisputably than the one cited, and thus anyone desirous of taking an interest in the patent, and who might not agree with the Comptroller as to the completeness of the anticipation by the patents cited, would not be put in full possession of the facts on this point. The question of what constitutes a complete anticipation of an invention frequently turns upon such small differences between the two inventions, that the Comptroller and the law officer not being experts in the particular industry or art, might well overlook them, if the applicants fail to point them out. In view of this possibility, although the Comptroller proposes to inform the public that the reference is made in consequence of a provisional investigation only, I think that even when there is only the slightest and apparently unimportant difference between the two inventions, the search should be continued to completion.

In conclusion, I may be allowed to recapitulate shortly the main points which I have endeavoured to bring out in this paper.

I say firstly, that the system of examination with power given to the examiners to refuse the grant of a patent on the ground of alleged want of novelty as carried out by the German and United States Patent Offices, and those of many other countries, is detrimental alike to the interests of the inventor and to those of the State; that even admitting the system to be correct in theory, it is not practically possible to carry it out in such a manner as to be perfectly equitable to the inventor whilst safeguarding the interests of the community; that to attempt to carry out the system with the very inadequate staff at the command of the Patent Offices of those States constitutes a great injustice to the inventors.

Secondly, that it is an injustice to the inventor to oblige him to go to the expense of an appeal from the decision of a primary examiner; that when the views of the examiner differ from

those of the inventor it should be the duty of the former to lay the matter before the higher authorities, and only if these confirm his decision should the inventor be called upon to argue the case further. This, I am glad to notice, is the system provided for by the new rules of our Patent Office.

Thirdly, that the correct system of examination is that about to be adopted by the English Patent Office under the Act of 1902, always provided that an adequate examining staff be appointed and that the most perfect possible system of classification of the inventions be established for enabling the work of searching to be carried out in a perfectly efficient manner, so that the inventor shall not be put to unnecessary trouble in having to prove the novelty of his invention.

Lastly, that the Patent Office instead of being, as it now is, a mere branch of a second-rate Government Department, should be elevated to the position of an independent Government Department, directly responsible to the Cabinet and Parliament, as constituting the worthy representative of one of the main sources of England's greatness and prosperity.

APPENDIX I.

Vogt and Recklinghausen's Invention.

Ruling of the Examiners-in-Chief upon the decision of the primary examiner rejecting the application.

As to the second* ground of rejection, the validity of these claims as true process claims under the decisions of the Courts, is too plain to admit of discussion. See Cochrane *v.* Deever, 94, U.S. 780, 792, where the claim was:—

> "The hereinbefore described process for manufacturing flour, and then taking out the pulverulent impurities by subjection to the combined operations of screening and blowing, and afterwards re-grinding and re-bolting the purified middling."

J. K. Williams Co. *v.* Miller and Co., 970 g., 2308, where the claim was:—

> "The process herein described of applying a cigar wrapper to and around the filler, which process consists in holding the wrapper, by air pressure, flat on a perforated table, and in thereupon gradually rolling it around the filler, the unrolled portion being meanwhile held to the table by air pressure, substantially as specified."

In *re* Weston 940 g., 1786, C.D. 1901, p. 290, where one of the claims was:—

> "1. The described method of manufacturing a symmetrical movable coil for an electrical measuring instrument, consisting in first forming a supporting frame or spool by subjecting a short tube of metal to pressure until the desired conformation and shape is obtained, then winding the coil thereon and finally securing the pivot pins thereto in the axial line of the coil."

The Court also said:—

> "It seems to us from all these authorities the deductions to be drawn are the e:—First, that processes involving a chemical or other elemental action, if new and useful, are patentable; second, that a process, which amounts to no more than the function of a machine, is not patentable; third, that a process or method of a mechanical nature, not absolutely dependent upon a machine, although perhaps best illustrated by mechanism, may, if new and useful, be the proper subject of a patent, even though it involves no chemical or other elemental action."

Even though it be admitted that the result of the step of compressing the explosive mixture by a liquid piston is the same as if that compression had been effected by a solid piston, yet, in the former case, no moving mechanism is employed, and the intrinsic character of the step is clearly of the same character as the pneumatic steps in the first two cases above stated.

The question whether there is or is not a true process in these claims is determinable by the answer to the question whether there is any force operating it to effect the result other than the force of the mechanism employed, see Busch v. Jones, 990, g. 205. If the answer is no, there is no such process. If the answer is yes, then there is a process.

In these claims there are two forces which are not those of the apparatus merely; first, the force of a necessary body of water operating on a gaseous body to compress it, and second an expanding force of those gases when expanded, operating on that forcing body of water. Here are two forces co-operating, neither of them the force of the mechanism, to perform the useful result of the procedure, and these two non-mechanical forces operate on each other. It follows that the claims express an art in the meaning of the Statute.

APPENDIX II.

A United States patent was applied for for an evaporating apparatus, in which a series of upright walls of serpentine tubes, heated internally by steam, were placed side by side, and between each two walls were placed upright corrugated plates, the liquid to be evaporated being made to flow down both the tube walls and the plates, that flowing down the latter being evaporated by the heat radiated from the tubes. Previously, such apparatus had been constructed with the tube walls only, and by substituting for every intermediate tube wall a single plate, the cost of the apparatus and consumption of steam was considerably reduced, while the evaporative effect

* The first ground of rejection was an alleged anticipation by a prior patent which was also ruled to be erroneous by the Examiners-in-Chief.

obtained was shown to be practically the same in both cases. The United States examiner found that an evaporating apparatus had been previously patented, in which only upright plates had been used for the liquid to flow down, the evaporation thereof being effected by means of currents of hot air passed between the plates. In consequence hereof he refused the above application on the ground that there was no patentable invention in substituting for the alternate pipe walls of the one known construction the plates of the other known construction.

On appeal to the Examiners-in-Chief they reversed the decision of the examiner, with the following statement:—

"We are unable to ascertain that either of the references discloses vertical plates intervening between and near to vertical walls of pipes, and a feed for the liquid leading to both pipes and plates. We understand that the statement of the examiner admits this novelty, his contention being that the new construction is not a new invention.

"To this conclusion we cannot agree. Inventors have been continuously striving to obtain greater range of distribution of the liquid relatively to a coil of pipes carrying the heating medium. This arrangement gives a greater liquid evaporating surface for the contact of the air currents than any other arrangement of pipes affords; it is, therefore, an improvement in such structures. An improved result of a kind which is material in the art, affords a presumption of more than the effort of ordinary mechanical knowledge and experience. There is nothing in the record to overcome this presumption."

APPENDIX III.

A German patent was applied for in respect of an invention connected with ice-making machinery. The invention related to the compressor cylinder, one improvement relating to the cylinder itself, and another to the valves of the cylinder.

The examiner insisted that these were two independent inventions requiring two separate patents, and after long arguments on the point, the inventors complied with the examiner's request, and filed a separate application for the valve construction, limiting the original application to the cylinder construction. Now both inventions had a common feature, namely, that the higher temperature of the incoming vapours was utilised for warming these parts of the apparatus through which the colder outgoing vapours had passed, and thus preventing an accumulation of rime in the passages. Unfortunately in dividing the applications, a claim was added in the one for the cylinder construction in which this interchange of temperature was referred to and a similar reference to such interchange was also made in the original claim for the valve construction.

The examiner, in looking at the amended specification of the original application, saw these words in the claim in question, and without taking the trouble to read the claim through jumped to the conclusion that the inventors were still claiming in this patent the construction of the valves, and he thereupon without further ado refused the application on the ground of non-compliance with the request for the separation of the valve invention from that relating to the cylinder. The inventors were thus put to the considerable expense of appealing against the examiner's decision, owing to his carelessness in not properly reading this specification. The following further absurdity occurred in this case. As before stated, the inventors in compliance with the examiner's decision, lodged a separate application for the valve construction; for the proper understanding of this invention, it was necessary to show in the drawings the complete compressor cylinder, which, of course, also showed the above mentioned improvements in that construction; but, naturally, as according to the examiner's decision that the latter had nothing to do with the valve construction, the description of it was entirely omitted.

The examiner having considered this new application, was good enough to say that the subject-matter appeared to be patentable, but before passing the application he would require some description of the new cylinder and piston construction, to be inserted, as he considered it necessary that some explanation should be given in that respect. He thus contradicted his own previous decision that the two parts of the invention had no relation to each other.

APPENDIX IV.

Supreme Courts of the United States. United States *ex. rel.* Steinmetz *v.* Allen, Commissioner of Patents. Decided February 23, 1904. Abstract of the Judgment of the Court. Statement of the Case.

This is a petition in mandamus filed in the Supreme Court of the District of Columbia to compel the Commissioner of Patents to require the Primary Examiner to forward an appeal, prayed by the petitioner, to the Board of Examiners-in-Chief, to review the ruling of the Primary Examiner requiring petitioner to cancel certain of his claims in his application for motor-meters.

The Supreme Court dismissed the petition, and its action was affirmed by the Court of Appeals.

The writ of error was then sued out.

The decision of the Primary Examiner was based upon Rule 41 of practice in the Patent Office, and the case involves the validity of the rule under the Patent Laws. The petitioner filed an application in the Patent Office, November 21, 1896, for a patent for "certain new and useful improvements in motor-meters." He expressed his invention in thirteen claims. The first six were held by the Primary Examiner to be claims for a process, the balance of the claims to be for an apparatus; and on the 15th

May, 1900, ordered that the latter—that is, claims, 7, 8, 9, 10, 11, 12 and 13, be cancelled from the application.

In other words, he required a division between the process claims and the apparatus claims in accordance with Rule 41. That rule is as follows:—

41. Two or more independent inventions cannot be claimed in one application; but where several distinct inventions are dependent upon each other and mutually contribute to produce a single result, they may be claimed in one application.

Claims for a machine and its product must be presented in separate applications.

Claims for a machine and the process in the performance of which the machine is used must be presented in separate applications.

Claims for a process and its product may be presented in the same application.

Petitioner persisted in his application as filed, and the Primary Examiner repeated his order for a division of the claims. Petitioner regarded such order as "a second final rejection" of his claims to the apparatus, and appealed therefrom to the Board of Examiners-in-Chief. The Primary Examiner refused to answer the appeal and to forward the same with his answer thereto, and the statements required by the rules of the Patent Office.

Thereafter, on the 20th August, 1900, petitioner petitioned the Commissioner of Patents to direct the Primary Examiner to forward said appeal, which petition was denied. It was repeated to the present Commissioner, defendant in error, and by him denied on the 7th February, 1902. These facts constitute petitioner's claim to relief.

* * * * *

Mr. Justice McKenna, after stating the case as above, delivered the opinion of the Court.

After deciding upon the question of the jurisdiction of the Court, he said:—

"The issue is well defined between the parties, both as to the right and remedy, in the Patent Office. As to right, the petitioner contends that a union by an inventor of process and apparatus claims, which are essentially the same invention, is given by the Patent Laws, and that Rule 41, so far as it takes that right away, is repugnant to those laws and invalid. As to remedy, that the decision of the Primary Examiner constituted a final decision upon the case, and petitioner was entitled to an appeal under Patent Laws to the Board of Examiners-in-Chief. The latter proposition depends upon the first.

Assuming the right in an inventor as expressed in the first proposition, the Primary Examiner denied the right. True, a distinction can be made between his ruling and one on the merits, if we regard the merits to mean invention, novelty, or the like. But in what situation would an applicant for a patent be? If he does not yield he will not be heard at all, and may subsequently be regarded as having abandoned his application (see 4894, R.S.) A ruling having such effect must be considered as final and appealable.

Whether, however, to the Examiners-in-Chief or to the Commissioner, and from the latter to the Courts, we may postpone answering until we have considered the right of an inventor to join process and apparatus claims in one application.

There is nothing in the language of the Section 4886 of the Revised Statutes which necessarily precludes the joinder of two or more inventions in the same application. But the section does distinguish inventions into arts (processes), machines, manufactures, and compositions of matter, and the earliest construction of the law denied the right of joinder. An exception, however, came to be made in cases of dependent and related inventions. The decision would seem to imply that not the statute but the practice of the Patent Office required separate applications for inventions, but the cases cited were explicit of the meaning of the Statute.

Can it be said that a process and an apparatus are inevitably so independent as never to be "connected in their design and operation?" They may be completely independent (Cochrane *v.* Deener, 94 U.S. 780), but they may be related. They may approach each other so nearly that it will be difficult to distinguish the process from the function of the apparatus.

* * * * *

The Patent Office has not been consistent in its views with regard to the division of inventions; at times convenience of administration has seemed to be of greatest concern; at other times more anxiety has been shown for the rights of inventors.

The policy of the office has been denominated that of "battledore and shuttlecock" and Rule 41, as it now exists, was enacted to give simplicity and uniformity to the practice of the office. Its enactment was attempted to be justified by the assumption that the Patent Laws gave to the office a discretion to permit or deny a joinder of inventions.

But, as we have already said, to established a rule applicable to all cases is not to exercise discretion.

Such a rule ignores the differences which invoke discretion, and which can alone justify its exercise, and we are of opinion, therefore, that Rule 41 is an invalid regulation. Having settled the right of appellant, we may now return to the consideration of his remedy.

* * * * *

The Commissioner justifies his decision by the rules of the Patent Office, and a long practice under them. If there is inconsistency between the rules and statute, the latter must prevail. But the Primary Examiner did not follow the rules.

The rules provide that if an appeal be regular in form he shall within five days of the filing thereof furnish the Examiners-in-Chief with a written statement of the grounds of his decision on all points involved in the appeal, with copies of the rejected claims and with the references applicable thereto.

If he decide that the appeal is not regular in form, a petition from such decision may be made directly to the Commissioner. The regularity of the appeal in form is not questioned in the case at bar, and it was the duty of the examiner to answer the appeal by furnishing the Examiners-in-Chief, the statement provided for in Rule 135. A petition to the Commissioner was not necessary except to make the examiner to perform his duty.

The judgment of the Court of Appeals is therefore reversed, with directions to reverse that of the Supreme Court to grant the writ of mandamus as prayed for.

NOTE.—It is of interest to observe from the above, that it took the inventor, Steinmetz, over seven years (from 21st November, 1896, date of his application, to 23rd February, 1904, date of judgment) to establish his rights as against an improper rule of the Patent Office, and the improper action of the examiner.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said it could not be denied that the question of how the patent laws ought to be framed for the benefit of the proper parties was a very difficult one, and the mere fact that in all countries the way of carrying out the patent laws was different, showed that there was still an uncertainty as to what was the right way to frame them. With the two first conclusions of the author he was absolutely in agreement, but he would go a little further and say that all official examinations of patents were an evil. The author did not say that the proposed system of examination of English patents had exactly the same faults as the German and United States examinations had. The remedy lay, in his opinion, in making the inventor search for himself. It was a curious thing that the author in 1865 stated exactly what was the right thing, viz., that the Patent Office should be made a technical guide and purveyor of useful knowledge to the inventor and to the public generally; then if anybody had an idea which he thought might be made into a patent, instead of going and filing a description of the idea, he ought to be able to go to the Patent Office and say to one of the officials, "I have got an idea for a new set of bearings; will you please direct me to that part of the office where information can be obtained about bearings," and then the inventor could sit down and study the subject. The inventor himself knew perfectly well what his invention was, and what advantages attached to it, and he could read all prior applications for patents for bearings with a totally different mind to that of an official examiner. The author had given instances, which occurred every day, where the examiner did not understand the invention or had not troubled to make himself perfectly acquainted with it, and had stated that an enormous staff of examiners was required to deal adequately with the question. The staff of the Patent Office should be employed in registering all information that came in, and he thought the idea of a roving commission was an extremely good way of collecting information. The information should be indexed and analysed as much as possible, so that when an inventor came for certain information he could get it quickly. His objection on the subject was that the original Statute of Monopolies did not say that the inventor should be the person who benefited; the statute said "The privilege shall be granted of the sole working and making." It referred to the privilege of working and making, and not to inventing, and that was the object of the law. It would be seen also that "Communications from abroad" were placed on exactly the same footing as original inventions. It was not the man who suggested a new idea who ought to be rewarded, but the man who introduced it; but it must not be forgotten that in most cases he was one and the same person. For instance, the names of Bessemer and Siemens were mentioned in the paper; they were inventors certainly, but they also introduced their inventions, and it was not for the inventing that they got their reward, but for the introducing, and that was really the point on which the whole patent legislation of the present time in all countries went wrong. It was easy to invent, there was nothing in that, but it was extremely difficult to introduce a new manufacture, and the people who did introduce new manufactures ought to be the people who were rewarded. If the judgments in important patent cases were read, it would be found that the Judges were of exactly that opinion, and it was also in conformity with the principle that the real proof of the value of an invention was its adoption. If an invention was not worth adopting it was not worthy of reward. It was a common mistake to say that there were lots of inventors who went about but could not get a manufacturer to adopt their invention, and that therefore good inventions went begging and the public lost. That appeared to be so, and the inventor who said that was no doubt perfectly honest. For instance, if an inventor came to him with an electrical invention it was ten to one that he (the Chairman) knew more about it than the inventor did. If it was a thing on which his firm had made experiments a few years previously, and knew that it was commercially impracticable, he said to the inventor that he was very sorry he could not make use of the invention, but if he gave reasons, the inventor would begin to argue, and, as Sir William Siemens used to say, when an inventor came to him, he knew he would lose two hours of his valuable time, and would make an enemy for life. It was a mistake of the patent laws of all countries to try to reward an inventor simply because he had made an invention. That was not enough; he ought to introduce it, because by its introduction he proved that it was valuable. There was no other proof, and if the man succeeded in introducing it, then the law ought to go further, and grant him

a real monopoly. The author had instanced a case in which it took an inventor seven years to induce the United States Patent Office to allow an appeal, and even then his patent was worth nothing until he had fought a law suit. Under the present patent laws, in any country a real patent was not obtained until it had been fought through a court, but, in his opinion, when an invention was introduced commercially, a patent should be granted to it which could not be upset, and thereby the introducer of the invention would get a real benefit.

The SECRETARY read the following letter from Sir Lloyd Wise:—Being under engagement to preside at a large gathering this evening, I am, unfortunately, not in a position to avail myself of the courteous invitation of the Council to attend to-day's meeting of your Society. This I regret the more because, having co-operated for nearly thirty-five years with my friend and professional colleague, Mr. C. D. Abel, in the promotion of patent law reforms, I should have been peculiarly interested in hearing his paper read.

I, of course, do not know that particular branch of the subject he will deal with, much less the views to which he may give expression. But, in the interest of inventors, I desire, if in order, to direct special attention to the new patent rules, which seem to me highly objectionable.

In my opinion they point to about the most obnoxious method that could possibly have been devised of carrying out the provisions of Section 1 of the Patents Act of 1902. This is the more unfortunate because effect might readily be given to those provisions in a manner that would prove advantageous both to inventors and the public.

I suggest, in particular, that the utmost possible pressure should be promptly brought to bear with the view of getting the rules so far modified that in carrying out Section 1 of the Patents Act, 1902, the special forms of reference to prior patents set out in Rule 10 of the Patents Rules, 1905, shall apply only in cases where the applicant has not already mentioned the prior patent in his specification, and has been duly notified of the Comptroller's determination that a reference to a prior specification ought to be made, and has failed to embody in his own specification, in his own way and within a specified reasonable time, a reference by number, year, and name to such prior specification.

As I see that Mr. Alexander Siemens is to preside, I can, perhaps, best illustrate my meaning by referring, by way of example, to one of his firm's own patents, in obtaining which Mr. Abel's firm acted professionally. It is No. 6220 of the year 1899, and in the complete specification there is given an outline of the state of the art, and a prior specification of Jablochkoff's, No. 1996 of 1877, is specifically mentioned.

That is one example of the sort of unobjectionable reference I contemplated when giving evidence before the Departmental Committee in 1900. But according to the new Rule 10, if the applicant once goes the length of troubling the Comptroller to determine whether reference ought to be made in the applicant's specification to any, and if so, what, prior specification or specifications by way of notice to the public; then, should the Comptroller's decision be affirmative, an official notice is to be placed upon the unfortunate applicant's specification in these terms:—

"Reference has been directed, in pursuance of Section 1, Sub-Section 6, of the Patents' Act, 1902, to the following specification of Letters Patent, No. ....granted to......................."

Where the reference is inserted as the result of a provisional report, under Rule 7, a statement to that effect is to be added to the reference.

Surely an applicant should be allowed to take a patent at his own risk, provided he (himself) specifically mentions the prior patent or patents, reference to which is regarded as necessary for the protection of the public. The mention thereof by No., year, and name, would obviously be a notice to the public, inasmuch as his specification is addressed to the public. Why, then, should it be in any way made known, to his prejudice, that he referred to the prior patent under compulsion? The contemplated practice will be tantamount to publication of an official report to the effect that, in the opinion of the Comptroller, the patent is invalid.

What justification can there be for thus handicapping inventors whom the patent laws are intended to encourage? Why not give the patentee absolutely fair play?

If the framers of the Act had contemplated the sort of practice seemingly intended to be set up, surely they would not have expressly prohibited, as they did in the Act, publication of reports of examiners, which, as a matter of fact, formed an essential part of the original scheme as approved by the Society of Arts, after full discussion, in 1877, and submitted by me, as the Society's delegate, to the International Congress at Paris in 1878.

In conclusion, I may mention that the whole subject is pretty fully dealt with in a leading article which appeared in *Engineering* of Friday last, 9th inst.

Mr. P. M. JUSTICE said he was in thorough accord with the bulk of the author's suggestions. He thought that if an examination was to be made, as it was now settled it was to be made from the 1st of January next, it should be as complete as possible. But, in his opinion, Mr. Abel had omitted one of the essential features of the examination, viz., the fact that the examination would in no way determine the validity or non-validity of the patent. Those who were familiar with patents knew that it was just as easy to anticipate a British patent, by the publication of the German specification or the American specification, so long as it was sufficient, as by an English specification. The examination in this country was to be limited simply to British specifications, not to British

or foreign publications, and he thought Mr. Abel might with advantage have pointed that out in his paper. He agreed thoroughly with the author that the examining staff should be increased. Apparently they did not have to work for so many hours as the poor German examiner, who topped the list. He had been told by the German examiners that they found it a physical impossibility to get through the examination of their cases in office hours, and that three nights in the week they took their papers home to work upon them. He did not think that ought to obtain in this country, and he hoped the examiners would not be overworked; at any rate he felt perfectly certain that we ought to have the best examination the examiners were capable of giving. He also believed there was going to be a very fair subdivision of inventions. Many present were aware of the Chairman's strong opinion, that it was the man who produced or worked the invention who should be rewarded, but he (Mr. Justice) ventured to say that the Chairman's firm had several hundred patents on their books, which were either in existence or which they had allowed to lapse, which they had never really worked as patents, and he would like to ask whether the Crown or the public was deprived of anything by the granting of those patents. If an inventor went to the Patent Office, and his patent was valid, he obtained a monopoly for fourteen years; if the invention was no good he did not work it, or get anybody else to work it, but no one was harmed thereby. He thought the Chairman might well cry quits to such an inventor. He agreed that where a man was successful in introducing an invention, he should be remunerated, if possible, and he saw no practical means of his securing such remuneration except by the grant of a patent.

Mr. G. G. HARDINGHAM thought the Legislature had scarcely appreciated the fact that inventions were peculiar things to deal with, which changed from day to day. The English system was based, to a large extent, upon the assumption that an invention was something of a definite character. So far as his experience went, it was of an indefinite character, and that was where a great many troubles arose, particularly in connection with the Provisional Specification system. It was very difficult to see how the system which was to be brought into operation in January next could be worked satisfactorily with the prevailing system of initiating applications on provisional specifications. It was true that the examination was to be made upon the complete specification, but inasmuch as complete specifications had necessarily to be founded upon provisional specifications, he thought very considerable difficulties would arise; and he hoped the system would be modified to the extent of abolition, because it was a thoroughly bad system. If a man was entitled to go to the State and ask for a patent, he should be able to define the invention for which that patent was sought, and he was not entitled to a grant which he could put in force against the public until he had defined the invention. Inasmuch as English patents were dated back to the date of the application, which, in the majority of cases, was that of the provisional specification, it would be seen that the patent was really granted upon something which was of an indefinite character, because it was founded upon the provisional specification. The difficulty turned upon the question of date, because patents were dated back in that way. If patents were dated from the date of the complete specification he would have no objection whatever, but until that inherent difficulty was abolished, he was afraid a satisfactory system would not be obtained. He had noticed, as Mr. Justice had pointed out, that the author had made no reference to the fact that the proposed examination was of a quite incomplete character. It seemed to him perfectly futile to examine merely a small branch of publications. A patent might be upset in this country upon the ground of prior publication, which might be found in the specification of a British patent within the last fifty years, or in the specification of a United States, German, French, or any other specification or publication, and to introduce a system of examination of that extremely partial character would be simply useless, and very misleading. English patents would be upset quite as often, as they were at the present day, on the specifications of United States patents as on the specifications of British patents. He entirely failed to see why, if there was to be an examination at all, it should not be the very best kind of examination procurable. If the United States and the German examiners could examine other specifications than their own, surely the British could.

Mr. OSCAR GUTTMAN thought the new system ought to be given a chance, but he was afraid the new examination would not be of much use. He agreed with Mr. Hardingham that an examination based upon British patents which only went back fifty years was, especially in the chemical industry, quite useless, and would exclude a very large source of information with regard to prior inventions contained in English and foreign literature. In a good many cases with which he was acquainted the search in foreign literature had been so fruitful of anticipations, in law cases and otherwise, that to limit the search in the way proposed was quite ridiculous. Another objection was with regard to the quality of the examiners. He happened to know the quality of the junior examiners in Germany, and also knew the standard for the assistant examiners who were selected in this country for positions under the new patent law. He was afraid the Germans would come out better in that respect, but he did not wish to discourage the young men who would be assistant examiners; probably in a year or two they would have greater experience than they at present possessed. In Germany an assistant examiner must have been at some works and had some practical experience, or he must have undergone a course

of very severe study. In this country assistant examiners were chosen, not according to the record of their study or work, but by means of the wonderful competitive examinations which existed in England, where generally not the clever men were at the top but those who went through an examination best, and it was well known what a curse the examination system had been in this country in all sorts of professions. The author had referred to a lecture he gave before the Society of Engineers, in which it was stated that the examiner should not have power to refuse any patent, except when it referred to some nonsensical matter. He did not think even that power should be given to an examiner. He knew of a case where the patentee applied to the German Patent Office, and an eminent professor told him that although the German Imperial Patent Office might grant a patent on an invention which might not prove useful, it was not the object of the Patent Office to grant a patent for nonsense, and that that patent was nonsense. The inventor thereupon requested the Patent Office to send a Commission to his works, and proved, to the astonishment of the Commission, that it was not nonsense and that it worked, and, strange to say, the famous Professor, who had given the previous opinion, later on wrote a book on the usefulness of the invention. He believed a great dea of harm was done by the system of examination in Germany, inasmuch as it was possible for an examiner to throw every obstacle in the inventor's way. The author had mentioned a case where a patent was delayed for seven years in America, and he (the speaker) was now investigating a patent which had been delayed for four years in Germany. The poor inventor, therefore, only had six or seven years left in which to develop his invention and make it useful, and this was very unfair to him. On the other hand, it was quite impossible that the inventor himself should search in the way suggested by the Chairman. The inventor was, in most cases, a child; he was so infatuated with his invention that he would not listen to reason. Whatever he read, he would find an argument in his own favour, and there must be somebody, either an expert outside or an expert in authority, who would tell him that he was wrong. There was another way of dealing with the question, namely, to give the public generally a right to object to a patent, which was the system prevailing in Germany, but the English patent law had set its face against that proceeding, and would continue to do so. Nobody in this country could oppose a patent unless he had a prior patent himself, which on some grounds or other was similar to the new one. If the outside public were allowed to search, and as a result of their search to oppose a patent, and a reference was then made, he thought the search would be useful, but not otherwise.

Mr. WALTER F. REID wished to express his agreement with most of the points raised in the paper, especially that which related to the searches which took place in Germany and the United States. If the searches were carried out in England in the same way as in the United States, they could only be an evil. The objections raised in the United States Patent Office were sometimes of a most stupid character; anything that bore in the most distant way on the invention was sent to the poor inventor to find a reason why it did not anticipate his patent. He hoped the English Patent Office was not beginning a state of affairs which at all resembled the procedure in America. He thought the figures given in the Table of the number of hours spent by the officials in searching were not altogether comparable. It must be borne in mind that the search which the English officials would have to carry out would be a very limited one; therefore, possibly the number of hours and the method they employed would be quite sufficient to do the work fairly, because, as he understood it, they would have only to investigate prior specifications in this country for 50 years, not the whole of the literature, as was done in Germany and the United States. He wished to dissent from the Chairman's remarks with regard to the introducer and the inventor. It might not always be quite so easy as it appeared to invent a thing, because it pre-supposed a very considerable study of the subject before one was in a position to invent; and it must also be remembered that some of the greatest inventors had been outside the particular business which was engaged in working the subject matter of the invention, Bessemer being a notable example. The quotation which the Chairman made was also rather antiquated. That was the view held some hundreds of years ago, but the present view was totally opposite. For instance, the patent for the Parsons turbine was prolonged simply because it had not been introduced, which he thought was fair, because an inventor might have spent a great deal of time in inventing his article, and yet it might not be introduced commercially, although it was a good invention. Therefore he thought the present view was much fairer than the old view which the Chairman had mentioned.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Abel, which he requested Mr. Bloxam to convey to that gentleman, said he did not desire to alter the way in which English patents were granted at the present time; he only desired that when the patent was introduced it should then automatically become a real monopoly, without a law suit.

The resolution was then put and carried unanimously.

Mr. BLOXAM, in replying on behalf of Mr. Abel, thanked the audience for the kind vote of thanks which had been passed. He did not know that he could venture to undertake to express Mr. Abel's opinions in reply to the points which had been raised in the discussion, but he thought Mr. Abel would be disposed to say to the Chairman that in patent

matters more than in anything else the old adage, "So many men, so many opinions," applied. With regard to the inventor searching for himself, when an inventor came to a patent agent, the first question he was asked was whether his invention was new, and the prompt reply was given that it was, and that he had spent so many days at the Patent Office searching, and could not find a single anticipation. The patent agent then produced his volume of abridgements, and turned up the anticipation at once. The inventor was very seldom sufficiently well informed in the art of searching, because it was a very considerable art to be able to discover anticipations of inventions. The remarks made by other speakers were very much to the point, and he could only thank them for having taken part in the discussion.

COUNTY COUNCIL SCHOLARSHIPS.

The scholarship systems both of the School Board and the London County Council have stood the test of time. At the end of the last financial year the total number of scholars and exhibitioners holding awards under the Council was 3,174. During last year there were 3,416 candidates for the Junior County Scholarships, 952 for the Intermediate, and 100 for the Senior. The county scholarship system has formed a ladder to carry on the junior scholars from the public elementary schools, and that the Council has been enabled to secure able candidates for its scholarships is shown by the fact that during last year alone no fewer than eleven of the Council's scholars obtained scholarships in the universities, or institutions of university rank. Many senior county scholars obtained degrees in honours, while in 1902 the Senior Wrangler was a London County scholar who had received his early education in a public elementary school. On the more technical side one scholar has recently been appointed a probationary constructor to the Admiralty. Many have been awarded research scholarships in science by the Royal Commissioners of the 1851 Exhibition; several of the Council's senior county scholars have assisted in the conduct of important research work; many of the Council's intermediate scholars have obtained good appointments in engineering works; and there are many instances of artisans improving their positions through the aid of the courses which they have pursued as evening exhibitioners in science or technology. But one of the results of the Education Acts of 1902 and 1903 is to compel a complete recasting of the scholarship system which the Council, through its Technical Education Board, has administered since 1893.

The Education Committee have now submitted to the Council a very bold and almost revolutionary scheme. The existing educational ladder from the board school to the universities is to be greatly enlarged. It is proposed that the present 600 scholarships shall be increased to 3,000, at a cost, when the new scheme is in full operation at the end of five years, of £275,200. The committee propose to abolish all examinations except the elementary test in arithmetic and English composition, or, to quote their own words, "Simple common-sense problems in arithmetic (including alternative questions so as to deal evenly with all candidates) and an exercise in English composition calculated to test not only handwriting and spelling, but more particularly intelligence and powers of observation and expression." The committee say that the objects of this choice and limitations of subjects are (*a*) to supply the indispensable element of comparison among the candidates from the whole of London without encouraging special preparation; (*b*) to enable the examiners to judge intelligence rather than mere memory work, and (*c*) to leave open to candidates of varied tastes a way of displaying that intelligence. It was urged upon the committee that the system of selecting the ablest children from London as a whole results unfairly to the children in the poorer districts, and that a proportionate quota of scholarships should be allotted to each district. The committee dissent from this view. Experience shows, they say, that the winners of the Council's scholarships during the past eleven years have come from every part of London, poor as well as rich. "A considerable number of these scholarships have been won by children coming from extremely poor homes, the sons and daughters of dock and other labourers, porters, carmen, charwomen, needlewomen, &c. Though the proportion per district of scholarships to the children in public elementary schools has varied in particular examinations from 0 per 1,000 to 2·7 per 1,000, this variation by no means corresponds to the poverty of the constituency, the districts standing lowest on the list being Paddington (South), Westminster, the Strand, and the City, as well as Finsbury (East), St. George's-in-the-East, and Holborn; whilst relatively poor neighbourhoods such as Rotherhithe, Hackney (Central), Deptford, and Finsbury (Central), have secured high places." The committee feel that to allocate a definite number of scholarships to each district must necessarily diminish the keenness of the competition, lower the general average of quality, and result in the exclusion of able children in some districts by less able candidates from other districts. The local distribution of scholarships seems rather to depend upon the character of the schools, and the amount of attention paid to the matter, than the relative poverty of the district. Moreover, even within each district there are poor streets and relatively rich ones, highly efficient schools and schools working under less favourable conditions, so that, in the opinion of the committee, the allocation of a fixed grade to a district would fail to secure scholarships to the poorer streets and the weaker schools.

Hitherto only children whose parents were earning not more than £3 a week have been eligible for junior county scholarships. The committee propose that

any child who has attended any elementary school for two years may become a scholarship holder. In the opinion of the committee, the restriction of the competition to the children of parents below a certain income is invidious. It lowers the average standard of quality by excluding some able children whose parents may not really be in better circumstances than others below the limit. To quote from the Report, "The Council's scholarships should be, it is said, not badges of poverty but titles of honour. Moreover, it is desirable, on many grounds, that a mixture of social classes in the public elementary schools should be encouraged. Especially is it important that the present growing tendency of middle-class girls to enter the teaching profession should not be discouraged, and that the way should be left open for the future pupil teachers to be drawn from all social classes. On the other hand, we feel very strongly that it is only by the firm retention of an income limit, at any rate, as regards the payment of maintenance, that access to the scholarship ladder can be made really effective to the clever childen of the poorest homes." The junior county scholarships will, as we have said, be open to all children living within the administrative county, who have been for at least two years attending an elementary school, and with regard to a money payment (maintenance allowance) in addition to free education, the committee recommend that it should be dissociated from the widely published scholarship award and granted separately by the Council only to those scholars who require it. By this separation, the Committee think the Council can combine "the very great advantage of making its junior county scholarships titles of honour without being badges of poverty, whilst continuing to confine its maintenance grants to those who need them. It would no longer be possible to identify a junior county scholar as necessarily coming from a poor home."

A scheme so wide in its scope, and so costly to the ratepayers—in addition to the £275,200, there must be a heavy outlay for more secondary schools—is certain to be hotly discussed. The objections most likely to be urged may be summarised as follows:—(a) The drafting of 3,000 children every year into the secondary schools. (b) The abolition of all examinations, except an elementary test in arithmetic and English composition. (c) The hostility shown to special scholarship classes. (d) The selection of twice as many girls as boys. (e) The restrictions on the continuance of the scholarships after 14, unless a bond to become teachers is entered into. (f) The injustice to some of the poorest scholarship holders in depriving them of advantages to which they are justly entitled, by reason of their parents' inability to enter into a bond that their children (then 14) shall become teachers at 16, and enter a training college at 20. The last three criticisms are urged in a memorandum to the committee presented by the London Teachers' Association, which considers that "the great blot in the whole scheme appears to be the desire to secure candidates for the teaching profession, rather than to improve the general education of the children."

*TECHNICAL EDUCATION IN INDIA.**

When India passed under the rule of the Crown, the Government found a more or less widespread, but very rudimentary, system of education in vogue. There were Hindu village schools, generally of a secular character, and Muhammadan schools primarily devoted to religious instruction. From an early date also the missionary societies have played a prominent part, both in educating the low castes, aboriginal races and female populations, and in maintaining institutions attended by the more advanced sections of the population. Of the primary and general education mention need not be here made. On the other hand the scope of the professional and technical training afforded is so vast and of such importance to the welfare of our Indian Empire generally as to merit a brief review. The principal subjects are law, medicine, engineering and surveying, agriculture, veterinary science, forestry, commerce, art, and industry. Law is taught mainly in the Government law colleges, situated in the capitals of the various provinces. Medicine is taught in two grades, the upper at four large Government colleges, and the lower at eleven Goverment schools. The colleges train students for the assistant-surgeon class for employment in State hospitals and dispensaries, the schools training students for a lower or hospital assistant class.

The work of the engineering colleges at Rurki, Sibpore, Poona, and Madras in preparing subordinate officers for the P.W.D. is well-known. Sibpore and Poona, have, however, an agricultural side, while other institutions such as the College at Saidapet, and special schools at Cawnpore and Nagpur are purely devoted to agriculture. The various colleges and schools devoted to veterinary science, together with the Imperial Forest School, train their students mainly for positions in Government employ.

The writer of the report does not regard the present condition of commercial teaching with much favour. There is very little of an advanced character. A number of schools teach shorthand and type-writing, and a smaller number give more or less elementary instruction in book-keeping, correspondence, commercial geography and kindred subjects.

There are four schools of art under Government control. Their special function being to restore, develop, and improve the application of oriental art to industry and manufacture. Of these schools that at Madras, on its industrial side, deals with the manufacture of bricks, tiles, pottery, water-pipes, smith's work, &c. The connection between decorative art and this department is therefore very slight. On the

* "Progress of Education in India." Fourth Quinquennial Review, Cd. 2181, 2 vols. Published by Eyre and Spottiswoode. (1904.)

technical side, drawing, painting, modelling, wood engraving, and copper-plate engraving are taught. This school does not seem to be in a very flourishing condition. The number of students has fallen steadily from 633 on March 31st, 1897, to 321 on the same day in 1902. Higher fees, and a rule requiring unpaid apprentices to pay class fees for attending drawing classes, are ascribed as partial causes of the decline. Further, the Government technical examinations held in 1901 were not very favourable to the school.

The Bombay School of Art dates back to 1857. At present (in addition to the Reay art workshops opened in 1891) the institution comprises a drawing school, modelling and painting classes, together with drawing teacher's course, and an architecture and draughtsman's class. The trained pupils find ready employment, its students having executed much of the decorative work which adorns the city of Bombay. In the art workshops house painting and decoration, enamelling, gold and silver work, carpet weaving, copper, brass, and iron work, wood-carving and pottery are each taught. The number of students, which fell on account of the plague, has since increased greatly, and the institution is both flourishing and improving.

The Calcutta School of Art, on account of the sparsity of indigenous art in Bengal, has no manufacturing industrial side. Systematic instruction is given in drawing and design, for teachers, draughtsmen, artisans, and art designers. Wood engraving, lithography and modelling are taught. The number of pupils has fallen slightly during the quinquennial period under review.

The Mayo School of Art at Lahore gives instruction in the arts of design, with special reference to the indigenous industries of the Punjaub. The majority of the pupils—whose numbers are increasing—are of the artisan and trading classes. Some of its pupils have been employed as designers in the Punjaub carpet factory. Of the twenty-eight pupils who left in 1901-02, all but two have obtained suitable employment ,none, however, appearing to follow the indigenous handicrafts, which it is the special province of the school to encourage and foster.

Space does not avail for the treatment, even in abstract, of the various industrial schools, of the Government, local board, reformatory or "aided mission" types. Generally speaking, these have not been very successful. In many cases, it has been necessary to attract pupils by means of stipends, the stipend-holders, being often boys of the non-industrial classes, who attend merely for the sake of the literary instruction which is combined with the industrial training. To those who consider Blue-books dull or tedious, this quinquennial report may well be commended. It is likely to interest even those who do not study educational systems. To those, however, who are interested in education, primary or secondary, this record of progress will be almost invaluable, as treating of problems which confront no other governing race in the world.

THE SHANGHAI RIVER CONSERVANCY

The following information respecting the important question of the improvement of the Shanghai River Navigation (*see ante*, vol. lii. 860), is from *The Times* correspondent at Shanghai, dated December 2nd:—

Sir William Bredon, Deputy Inspector-General of Customs, goes to Pekin to-morrow. He intends to submit for the consideration of the Wai-wu-pu and the Diplomatic Body certain proposals, approved by the Nanking Viceroy, Chou-fu, for a scheme with reference to the Shanghai River Conservancy, to be embodied in a new convention to take the place of Annex 17 of the Peking Protocol. The scheme follows generally the lines of the recent despatch of Sir Ernest Satow to the Wai-wu-pu accepting the principle which was originally enunciated by the Viceroy Liu Ku-nyi, that China should carry out the work at her own charges under the supervision of the Maritime Customs, giving guarantees for its due performance.

With regard to the nature of the guarantees the Viceroy was unable to accept Sir E. Satow's conditions, which are stringent, but he expressed a desire to begin the undertaking forthwith and stated that there could be no difficulty as to funds being regularly forthcoming in advance. A memorandum setting forth the proposals is now under consideration by the Chamber of Commerce and the Municipal Council, and it is probable that these and other local bodies will support them. It is evidently desirable that the Diplomatic Body should seize the occasion of the new progressive Viceroy's appointment in Nanking to supersede the unworkable Protocol by a practical solution of this important question.

The Viceroy, Chou-fu, during his stay in Shanghai has created a universally favourable impression. His appointment to Nanking is timely because his influence is calculated to counteract the policy of Chang Chih-tung at Wu-chang, which since 1901 has steadily become more reactionary and ill-advised.

CORRESPONDENCE.

THE BRITISH CANALS PROBLEM.

As I understand Mr. W. D. McConnell, he admits:—

1. That the utility of our waterways may be largely increased.

2. That some remedy for the existing condition of the waterways should be found.

But he argues:—

1. That if private owners have a fair field for their enterprise they will not hesitate to incur expenditure in the improvement of their property.

2. That it would be a disastrous policy to give power to local authorities to add to their burden of debt.

3. That it is doubtful if sufficient data can be given to show even a probability of a sufficient increase of canal traffic to justify such a course.

In reply I contend :—

1. That it is impossible for private owners of canals to get a fair field for their enterprise so long as it is the deliberate policy of railway companies to crush canal traffic by carrying to competing points under cost, making up the loss thus sustained by increased charges to places where effective competition by water has been destroyed or does not exist.

2. That the cost of transport to inland towns of imported goods of universal consumption falls on the community as a whole.

3. That capital subscribed from private sources and expended on developing a waterway so as to reduce the cost of transport may be deprived of all return by a consequent reduction in railway freights. In this case all pecuniary benefit being reaped by a local community (*a*) at the expense of the private capitalists aforesaid; (*b*) at the expense of other localities who may have to pay higher railway rate to make good the loss sustained at the competitive point.

4. That to point to an increase of debts without considering any increase in the value of assets is not reasonable. It may, for example, be contended that the railway companies increased their burden of debt from £560,000,000 in 1872 to £1,217,000,000 in 1892, but this increase of debt would hardly be considered as evidence that the railway companies were pursuing a policy which would land them in bankruptcy.

5. That the Midland district, of which Birmingham is a centre, annually consumes 3,000,000 tons of imported food stuffs, timber, iron ore, lead, and zinc, of which 35 per cent. enters by way of the Bristol Channel ports; that a capital expenditure of £600,000 would enable craft to be loaded from ocean steamers and discharged in Birmingham without transhipment, and that such an improvement might cause such a reduction in existing rates as would effect a saving of a minimum of £150,000 a year in the cost of transport now paid by the local community served through Birmingham. ARTHUR LEE.

Hayes, Middlesex,
Dec. 11th, 1904.

MILK IMPURITIES.

Sir EDMUND VERNEY, Bart., writes:—On page 74 of the *Journal* the author of the very interesting article on milk impurities advocates "that the County Council should be empowered to act in default of the local authority;" surely they are so empowered at this moment; also that "it should be the duty of the Local Government Board to intervene in the ultimate resort." I should have supposed it was their duty already. The Bucks County Council cannot be persuaded to do anything for the sanitation of the county; for several years councillors have vainly endeavoured to get the council to act, and it would be quite useless to bestow upon them powers they would be certain not to exercise.

The writer of the article sends the following reply to Sir Edmund Verney's letter:—If Sir Edmund will turn again to the article to which he alludes he will find that it is the report of the interdepartmental Committee on Physical Deteoriation that makes the recommendations to which he refers. They are on page 53 of the report. And if he will turn to the evidence of Mr. Litheby, Assistant Secretary of the Local Government Board, in charge of the Public Health Department (page 501 of the "Minutes of Evidence"), he will find that no effective pressure can at present be exercised. Sir Edmund Verney's pamphlet on "The Sanitary Condition of Bucks" shows how necessary it is that in the last resort the Local Government Board should be in a position to compel.

OBITUARY.

LIEUT.-COLONEL C. SEBASTIAN SMITH, V.D.—Mr. Sebastian Smith, mining and land agent, died on Tuesday, the 6th inst., at his residence at Shipley, near Derby. He was born on March 11, 1841, and was educated at Leamington College. He was admitted a solicitor in 1866, but early in life he became a land agent. He was an ardent supporter of the volunteer movement, and was one of the first to join the Leicestershire Rifle Volunteers in 1859, in which corps he served thirty years, retiring with the rank of lieutenant-colonel. The Society of Arts Gold Medal for exhibits in the International Health Exhibition was awarded in 1884 to the Compressed Lime Cartridge Company (Shaw Trust) for Mr. Smith's improved method of breaking down coal, and he had previously obtained the bronze medal at the Amsterdam International Exhibition. Mr. Smith was elected a member of the Society of Arts in 1888.

GENERAL NOTES.

RUBBER AND COTTON CULTIVATION IN CEYLON.—The *Ceylon Times* announces that a notice will shortly be issued giving full details of the term and conditions on which the Government is prepared to lease land at specially low rates for pioneer cultivation. These terms are that if the purchaser will undertake to plant the land with cotton, rubber, or some other product approved by Government, a lease for 50 years at a minimum rate of 50 cents per acre will be granted him, or Rs.2·50 an acre, if irrigable from a Government tank.

CANADIAN WHEAT AND AMERICAN MILLERS.—The Washington Treasury Department has taken a step that must have far-reaching consequences. The exports of wheat flour from the United States, which in September, 1903, were 1,873,981 barrels, fell in the corresponding month of this year to 850,475, and the American millers found themselves within sight of the time when their export trade would disappear through failure of home material. And so they thought then of the supplies of Canadian grain over the border. But the American duty on wheat is 8s. 4d. per quarter, and constituted an effective bar to Canadian supplies. The Washington Treasury Department now consents to regard wheat as a raw material and flour as a manufactured article, and therefore to allow upon exports of American flour made from Canadian wheat 99 per cent. of the duty paid upon the importation of the latter. The result must be that large quantities of Manitoba wheat will be diverted to Minnesota, the centre of the milling industry of the United States. Given American free trade in Canadian wheat, the Canadian farmer is likely to find it more advantageous to send his grain to Minnesota than to forward it by way of an Atlantic port 2,000 miles distant for shipment to Liverpool. It may be remembered in this connection that Mr. Chamberlain proposes to "put such a duty on flour as will result in the whole of the milling of wheat being done in this country."

INDIA AND OUR WHEAT SUPPLY.—In the *Journal* of December 2nd attention was directed to the great shrinkage in the imports of wheat from the United States. It was shown that whilst in 1900 the United States sent us nearly as much as Argentina, Canada, Russia, and India combined, in the first three months of the current year these countries sent us nearly nine times as much as the United States. The trade returns for November show a heavy increase in the imports of wheat as compared with the corresponding month of last year, but the United States sent very little of it. At present nearly half our wheat imports are coming from India and Russia, a pregnant change from the days when we got most of the wheat we wanted from the United States. Commenting upon it the very able military correspondent of the *Times* writes, "These figures are very important. They are of course liable to variations from year to year owing to the failure of crops in one country or another, but as they stand they show that half our wheat imports come from India and Russia, and that with the cessation in case of war of Russian exports of grain by sea, India stands as our first and most important source of supply. It has become the granary of the Empire. The security of India is, in its last terms, a question of the preservation of the food of the people of England."

PRICE OF MEAT.—In a paper read a few days ago by Mr. H. C. Cameron on "The Products of New Zealand, with Specific Rreference to the Dairy Produce and Frozen Meat Industries," the lecturer said that "the introduction of frozen meat to this country had not curtailed the use, nor lowered the price, of home grown meat." On the contrary the price has advanced, as shown by the following figures which are taken from a Parliamentary Return on Wholesale and Retail Prices:—

	1886. d.	1903. d.
Fore quarters of Mutton	7½	8
Hind quarters	9½	10
Legs	10	10½
Chops	13	14

The price of New Zealand mutton was the same in 1903 as in 1889, but in the interval it had fallen considerably. On the other hand there was a marked rise in American beef coming to London in the same period, as will be seen from the figures below:—

	1899. d.	1903. d.
Sirloin	9½	11½
Fore ribs	9	9½
Silver side	7½	9
Beef steak	9	11
Rump steak	12	15

No doubt the importation of frozen meat kept the price of the home product from going higher than it has gone, but Mr. Cameron appears to be right in saying that prices are not lower since the importation of frozen meat began. As shown above they are higher.

BOARD OF TRADE RETURNS.—The trade returns for November show large increases. The imports are valued at £50,670,846, an increase of £1,947,255, equal to 4 per cent., and the exports at £26,113,288, an increase of no less than £3,075,495, equal to 13·3 per cent. It has, however, to be borne in mind that the month under review contained one working day more than November, 1903. It is noticeable that raw cotton is higher in quantity by 111,195 cwt., and in value by £551,129, equal to 4·5 and 7·8 per cent. respectively, due to larger receipts from the United States. Including the entrepôt trade, amounting to £5,713,065 (an increase of £907,786 as compared with the corresponding month of last year) there was a total turn-over in the over-sea trade of November of £82,497,000, or at the rate of £989,964,000 per annum. These are record figures. It should be noted that although the receipts of wheat were much heavier last month than in November, 1903—9,270,500 cwt. as against 8,745,000—the chief arrivals were from Russia and Argentina, very little coming from the United States.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 18.—"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES. SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., will preside.

JANUARY 25.—"London Electric Railways." By the HON. ROBERT P. PORTER.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 19.—"The Highlands of Sikkim." By DOUGLAS W. FRESHFIELD. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

JANUARY 24.—"The Manufactures of Greater Britain. I. Canada." By C. F. JUST.

APPLIED ART SECTION.

Tuesday evenings, at 8 p.m.

DECEMBER 20 (8 p.m.).—"Street Architecture." By THOMAS GRAHAM JACKSON, R.A. DR. G. B. LONGSTAFF will preside.

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILEY HEWITT. LEWIS FOREMAN DAY will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DAVID JAMES BLAIKLEY, "Musical Wind Instruments." Four Lectures (with musical illustrations).

LECTURE IV.—DECEMBER 19.—*Flutes.* [illegible] ern limitation of the name—Action of t[illegible] air-reed—Recorders and flageolets—Cone and cylinder flutes.

Programme of Musical Illustrations. Flute Solo, *Godard*, Mr. H. Warner Hollis. — Horn Solo, Romanza, *Karl Maty's*, Mr. T. Busby.—Concertstuck, *Reitz*, Flute, Oboe, Clarinet, Horn, Bassoon, and Pianoforte, Messrs. Hollis, Fonteyne, Gomez, James, and Busby.—At the Pianoforte, Mr. R. H. Walthew.

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Fountain, and Stylographic Pens." Three Lectures.

January 23, 30, February 6.

JUVENILE LECTURES.

Wednesday afternoons, January 4 and 11, 1905, at Five o'clock, CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Two ectures.)

LECTURE I.—JANUARY 4.—A short history of the early days of illustrated newspapers—Preparations or illustrating events—How sketches are made—Special war artists—Photography on the battlefield—The amateur photographer—Drawing from sketches Siege sketches by balloon post—Mafeking sketches by Colonel Baden-Powell—Production of process plates.

LECTURE II.—JANUARY 11. — Compositors at work—Preparation of stereos—Manufacture of paper—The printing office—Folding and stitching machines—Colour printing—Importance of good titles—The editor's waste-paper basket—Curious sketches: the Russian censor—Foreign illustrated newspapers.

The lectures will be fully illustrated by lantern slides. An exhibition of drawings will be shown on the walls.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. David James Blaikley, "Musical Wind Instruments." Lecture IV. (Flutes: Action of the air-reed—Recorders and flageolets—Cone and cylinder flutes. With Musical Illustrations.)

Faraday Society, 92, Victoria-street, S.W., 8 p.m. 1. Mr. Adolphe Minet, "The Electric Furnace: its origin, transformation, and applications (Part II.). 2. Messrs. F. Mollwo Perkin and W. C. Prebble, "Electrolytic Analysis of Cobalt and Nickel." 3. Mr. F. Gelstharp, "The Electrolytic Preparation of Tin Paste." 4. Mr. F. Gelstharp, "Note on the Electrolytic Recovery of Tin."

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. Lacy Ridge and J. S. Gibson, "Architecture and Building Acts."

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

TUESDAY, DEC. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Thomas Graham Jackson, "Street Architecture."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. T. Durant Beighton, "The Possibilities of the Indian Tobacco Industry."

Civil Engineers, 25, Great George-street, S.W. 8 p.m. Discussion on paper by Messrs. Arthur Wood Hill and Edward Davy Pain on "The Construction of a Concrete Railway Viaduct."

Statistical, in the Theatre of the United Service Institution, Whitehall, S.W., 5 p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

WEDNESDAY, DEC. 21...Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Discussion on Mr. F. J. Brodie's paper, "Decrease of Fog in London during recent Years." 2. Dr. W. N. Shaw and Mr. W. H. Dines, "The Study of the Minor Fluctuations of Atmospheric Pressure."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. J. W. Gordon, "The Theory of Highly Magnified Images."

NOTICE.—Two recent numbers of the *Journal* are missing in the set of the Public Library of New South Wales, Sydney, viz., Nos. 2,561, 20th December 1901, and 2,569, 14th February, 1902. The librarian of that library has made application for these, but unfortunately they are out of print. The Secretary will be greatly obliged if any member of the Society is able to spare these two numbers so that he may be enabled to supply them to the Public Library.

Journal of the Society of Arts.

No. 2,718. VOL. LIII.

FRIDAY, DECEMBER 23, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 4th and 11th, at 5 o'clock, by Mr. Carmichael Thomas, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

On Monday evening, 19th inst., Mr. D. J. Blaikley delivered the fourth and last lecture of his course on "Musical Wind Instruments," the special subject being "Flutes." The musical illustrations consisted of solos on the flute by Mr. H. Warner Hollis, on the horn by Mr. T. Busby, and a quintet on the flute, oboe, clarinet, horn, and bassoon by Messrs. Hollis, Fonteyne, Gomez, Busby, and James. Mr. R. H. Walthew accompanied the instruments on the pianoforte.

The Chairman proposed a vote of thanks to the lecturer, and to the gentlemen who had so ably performed the musical illustrations, which was carried unanimously.

ST. LOUIS EXHIBITION.

List of Awards to Members of the Society of Arts.

The following is additional to the list as already printed in the *Journal* (see November 11, 18, 25).

Edwin Thomas Beard, A.M.I.C.E., Engineer of the Marine Drive Works, Scarborough, Silver Medal.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, December 20th, 1904; George Blundell Longstaff, M.A., M.D., in the chair.

The paper read was—

STREET ARCHITECTURE.

By T. G. Jackson, R.A.

The subject on which I have been asked to speak to you to-night, is "Street Architecture." Two years ago, in this room, I had the pleasure of hearing a very thoughtful and suggestive paper on the same topic by Mr. Beresford Pite, and of taking part in the discussion that followed. The choice of his subject arose, naturally, from the alterations in the Strand, and between the Strand and Holborn, which were then either begun or about to be begun, and concerning which there was considerable difference of opinion. Since then, great progress has been made with the new streets and approaches, though it is still too soon to pass a final verdict on the architectural result. The old Strand which has delighted our eyes for so long, and which I remember saying on the former occasion had always struck me as being one of the most picturesque streets in Europe, is gone, and gone for ever, and it remains to be seen whether its successor will charm us equally, though in a different way.

It is right that when occasions arise involving sweeping changes on a grand scale, like those that are transforming this part of London at the present moment, the principles, if there are any, which ought to govern street architecture, should be sought for and examined. But these principles should not be kept for those occasions alone. These great schemes demand our attention only now and then, and it is important that the true principles of street architecture, if we can discover them, should be applied to works on a small scale

as well as to those of grand dimensions, to individual as well as to general cases. There is nothing, for instance, but good principles to prevent any freeholder from building or rebuilding his house in some incongruous fashion which will spoil a whole street. The sober dullness of such thoroughfares as Harley-street or Wimpole-street may be and has been rudely interrupted by new houses, in which individualism seems to have been provoked to excesses by the very monotony of its surroundings. The principle which has inspired these performances would seem to be a desire to show off at the expense of the neighbours, a principle not generally held to be commendable elsewhere than in architecture, and certainly not in keeping with English ideas of good taste or polite manners.

One principle, then, which ought to govern street architecture is surely that consideration should be had for neighbouring buildings. Because street architecture is social architecture, and it ought to conform to those rules of convention by whch men in society are governed. Buildings in a town street cannot indulge in the freedom that is permissible to a house in the country any more than the owner can live in town with the same easy disregard of appearances that he enjoys when he is away. In town, living under the eyes of his neighbours, he must submit to many social restraints of habit and costume in order to conform to the ways of the society in which he moves, or he will be thought an ill-bred person; and in the same way architecture, when she takes up her abode in the streets, must conform to social conditions, and show respect to the company in which she finds herself, provided of course that it be respectable. Architecture may be guilty of social offences quite as much as the architect. Violent interruptions, startling contrasts of demeanour, disregard of the conventions of society, efforts to shout down and overpower his company, which would put a man outside the pale in the civilised world, find a very close analogy in the pretentious buildings that one often finds thrust into the streets and squares of London without the least regard for the style of the work they interrupt or the scale of the buildings they overshadow. Can anyone look without irritation at the north side of Cavendish-square, where the fine symmetrically placed houses in the severe classic of 1770 are crushed by an enormous pile of nondescript architecture on one side of them; or look with satisfaction at the strange sky-scraping structure that mars the wholesome brick architecture of Hanover-square; or view without dismay the appalling intrusions that are breaking up and destroying the design of Regent-street, the one fine and consistent piece of street architecture in London? Many other instances will readily occur to the memory, where all conditions of scale and sight have been violated by the invasion of buildings which even if they would have been tolerable elsewhere, which as a rule they would not be, are doubly intolerable where they are on account of their incongruity.

These offences are more flagrant and mischievous in proportion to the architectural value of the neighbouring buildings that suffer by them. An example is to be seen at Great Malvern, where a huge pile of building has been allowed to grow up actually touching the west end of the Priory Church, and overshadowing it. There is another at Bath, where a monster hotel overtops the east end of the abbey close by. A familiar instance is to be found at Milan, where the west front of the Duomo, despite its enormous size, is crushed into comparative insignificance by the new buildings, and the prodigious front of the Galleria on the north side of the Piazza. I need not, perhaps, dwell on the mischief done to street views by the intrusion of engineering works, for this raises questions beyond the limits of our present subject. One may also hope that such enormities as the iron girder bridge across the foot of Ludgate-hill would not be permitted now-a-days, especially since railways in London have taken to burrowing like moles underground.

Nowhere, perhaps, is this architecture of self-assertion and disrespect for what is entitled to deference more offensive than at our ancient Universities. There, if anywhere, ought the public buildings, Academic and Collegiate, to be allowed precedence, for it is they that form the glory of the town and differentiate it from any other. But, inspired one might suppose by the old rivalries of Town and Gown the streets both of Oxford and Cambridge are being invaded by gaudy, vulgar architecture, as if to outshine the Colleges, reaching its climax in a smart Bank of dubious architecture and unspeakable splendour at Carfax, where the four main streets of Oxford meet.

The first principle, therefore, that I would lay down for town architecture is that there should be a consistency, a regard for the surroundings, an absence of vulgar rivalry in

display, corresponding to that consideration for others, which is the essence of good manners among individual men and women; that ordinary houses should subordinate themselves to buildings which, from their public uses or their architectual importance may fairly claim precedence; that, in fact, there should be a "comity" of conduct in architecture as well as in society; any violation of which should be condemned by public opinion as in bad taste, inartistic, and intolerable. How far we are from general acceptance of this standard of criticism, we can all judge by sad experience.

Another consideration that arises out of this, especially when there is a question of cutting through old towns and forming new thoroughfares, is that when the alterations approach or touch beautiful buildings, whether old or new, they should be designed so as fit them, and bring out their beauties and enhance their architectural effect. This is a principle that has been much more attended to abroad than with us. The Louvre must have gained enormously by the construction of the Rue de Rivoli, and the old Tuileries by the formation of the gardens and the Place de la Concorde. With us, hitherto, this principle seems rarely if ever to have been thought of, new streets and roads having been planned solely for convenience, easy gradients, and economy, with very little thought of artistic effect. What splendid opportunities have been missed, for instance, when the alterations were made at Hyde-park-corner, which, though they have facilitated traffic to some extent, have destroyed the little there was of orderly arrangement, when Decimus Burton's arch and screen stood in some sort of relation to one another. Now we have a shapeless expanse, a wilderness of irregular roads, dangerous to cross, in the midst of which float three island-refuges of various shapes, with a statue that seems to have lost its way. A still worse failure is that at the site of the old circus where Regent-street joins Piccadilly. This has destroyed Nash's fine plan, and given us an amorphous space, with the relics of the old circus on one side and nothing definite elsewhere, a mere accidental clearing in the middle of houses, where Mr. Gilbert's fountain seems to float in space without any relation to its situation. Imagine what a fine thing might have been made of this if Nash's scheme had been respected, his circus enlarged into a larger circus, or developed into a square with the fountain in the centre; or, better still, prolonged into a rectangle like the Piazza Navona at Rome, in which, besides the fountain, room might have been found on its axial line for Cleopatra's Needle, now so absurdly perched on the parapet of the Embankment, quite as one might say accidentally, without any relation to the architecture behind it, and certainly none to the river in front. It is not so that the obelisks have been treated at Rome and Paris, where they are made the focus or pivot of "place" or piazza. I could not help being struck, when walking from the Pantheon down the Rue Soufflot, with the fact that the Eiffel Tower, in the dim distance, faced me exactly on the central line of the street. The Eiffel Tower is not perhaps the most beautiful thing in the world, but so placed it had from that point of view a meaning—it acquired a certain value by its relation to circumstances and conformity to place, which it would not have had otherwise. I can hardly suppose this effect to be accidental; I would rather think it designed; but I am sure that no such conception would ever have entered the minds of our street engineers in London.

The fault, however, does not always lie with those who lay out thoroughfares in London. Considerations of economy, very properly, have to receive attention, and they very often come in to mar the fairest schemes. It does not, however, follow that these considerations should always be allowed to prevail over every other. When unusual opportunities occur of making a beautiful street, as for instance in the alterations of the Strand now in progress, it would be unworthy of a great capital to treat the matter solely or even mainly from the commercial point of view. Something must be conceded to the dignity of a great city; some generous allowance must be made for the desire of every worthy citizen that his thoroughfares should be beautiful as well as convenient. It must not be forgotten that the present chance of making a fine thing will not occur again, and that a mistake made now from a too parsimonious motive will lay up a store of disgust and irritation in the future, and a bitter regret for a wasted opportunity. This, however, is what we are threatened with in the case of the Strand between Wellington-street and the Law Courts. As far eastward as the end of St. Mary's Church there seems nothing to complain of in the frontage line adopted. A wide thoroughfare has been formed on the north side of the church sufficient for the whole traffic going eastwards. Other dangers threaten this part

of the scheme, which I will return to by-and-bye. The debateable line is that east of St. Mary's, running from it to St. Clement's, about which there has been a great deal of discussion and will probably be more.

The first line laid down by the London County Council seems to have been suggested with the intention of giving a sufficient and convenient roadway at the least possible cost. As long as it had a minimum width of 100 feet, that was enough from a utilitarian point of view, and carried with it the approval of the economists who regarded the scheme commercially. This, however, at once provoked a protest from those who looked beyond these considerations. It violated our second principle, that alterations which approach or touch beautiful buildings, should be designed so as to fit them, and to bring out and enhance their architectural effect, instead of obscuring it. Somerset-house, with its fine entrance—worthy in my opinion of comparison with that of the Farnese Palace at Rome—fortunately was not in the way; but the two churches of St. Mary-le-Strand and St. Clement Danes, planned carefully to suit the old lines of the street, presented an interesting problem for the new. It will be remembered that the first idea of the County Council was to demolish St. Mary's Church entirely, so that Londoners might drive in a straight line over its site from Charing Cross to Temple Bar, and if St. Mary's had gone, St. Clement's would, in all probability, have followed suit. The curious thing is that if they had disappeared at that time, the general public would have seen them go without any consciousness that they had lost something worth keeping. A protest which some of us published in the *Times*, was received with surprise, and almost incredulity:—

"The question of the artistic right of the Church of St. Mary's-le-Strand," writes one newspaper, "to continue and obstruct one of the main thoroughfares of London has now I suppose been settled. That the crumbling old pile is one of our most beautiful buildings from the loss of which we trust the finer sense of the community will save us is the sealed, signed, and delivered opinion of about thirty of our leading artists, architects, decorators, sculptors and actors. . . . No doubt it will be difficult for any vandal to deride the artistic qualities of this venerable ruin after so strong an expression of opinion."

This architectural critic was not alone in his astonishment at finding that Gibbs's fine church had merits. The London County Council, who received a deputation on the subject plied us with questions which showed that our objections had taken them also quite by surprise. We must do them the justice to say that when the value of the churches had been explained their destruction was countermanded, and they are now we hope safe, every subsequent plan being contrived so as to spare them.

But it is not enough merely to leave these buildings standing. Our principle requires that the new frontage lines should be disposed so as to fit the lines of the churches, and to bring out and enhance their architectural merits instead of obscuring them, and this the line laid down by the London County Council for the north side of the widened Strand signally failed to do. The difficulties were no doubt considerable; the two churches lie at different angles, accommodated to the old direction of the street, and they were both designed to be viewed endways and not sideways. To the artist's eye it was obvious that these difficulties were not met, had perhaps not even been observed by those who drew the proposed frontage line. Beyond St. Mary's it slopes away southward at a very awkward angle with the church, which will seem to stand all awry, and it cuts into the middle of St. Clement's west front, so that the church will have the effect of peeping round the corner, by which it will be half hidden when seen from the north side of the street.

The discussion which this scheme provoked was begun by a letter in the *Times* from Mr. Hamo Thornycroft, who proposed a new line considerably farther to the north and lying parallel to the flank of St. Mary's Church. This would have made a magnificent street, almost a "*place*," and have done ample justice to the two churches. It required, however, so great a sacrifice of building land as to be beyond the range of practical politics, and it was, I believe, afterwards modified by Mr. Thornycroft himself. The modification, however, did not affect the principle by which it had been inspired, which must commend itself to every artist and every one capable of appreciating the true architectural difficulties of the problem.

Other suggestions, calculated with more regard to financial considerations, followed. The Institute of Architects, who were good enough to invite me as well as Mr. Thornycroft to co-operate with them, proposed another frontage line, which was of the nature of a compromise. This, starting from the same point at St. Mary's as the line proposed by the Council, was pivotted round northwards till it cleared the front of St. Clement's Church into

which the former line had so awkwardly cut. A third line was proposed by Mr. Riley, the architect to the London County Council, which lies a little further to the south than the others, and so sacrifices less ground, but still clears the angle of St. Clement's. Both these plans naturally involve giving up a certain area of building land, and, of course, a corresponding increase of expense, Mr. Riley's plan being the more economical of the two. Poles were put up and lines drawn to show the effect of the various frontages, the result being to confirm the opinion of those who may be considered experts as to the defects of the frontage proposed by the Council. The Council's first plan, however, saved most money, and on that ground, I regret to say, it has, for the present, triumphed.

In the report of the Improvement Committee, dated October 20, 1903, it is calculated that the value of the land surrendered to the public by Mr. Thornycroft's plan was £350,000, representing rates to the amount of £5,583 a year. A plan submitted by the "further Strand Improvement Committee" involved the sacrifice of ground valued at £239,400, with a rateable value of £4,230; the plan of the Royal Institute would cost £70,000 in ground value and £1,097 in rates, and Mr. Riley's plan £59,000 in ground value and £962 a year in rates. All such calculations are naturally to a great extent conjectural, and must be taken on trust for what they are worth. For the uncommercial mind it is difficult to carry the imagination to the higher figures I have quoted. The report of the committee goes on to recite, at some length, that a width of 100 feet is "in every way ample for the present and prospective traffic," which nobody ever questioned, the objection being taken on quite other grounds. The only exception taken to their plan appears, they proceed to say, "to partake of the nature of an æsthetic proposal," which they seemed to think might safely be put aside as of no importance, and the Report was accordingly approved by the Council, and the original frontage line confirmed. The stone kerbing of the roadway is now laid down and the hoarding fixed which gives the frontage line of the future buildings, and anyone may satisfy himself of the ill-effect it will have on the two fine buildings which might so well have been worked into a regular plan on good architectural lines.

The plan will have an accidental haphazard character, with none of the dignity given by regularity, and it is one in which the very elements of true architectural treatment are not so much neglected as deliberately rejected. I venture to think that in no other capital of Europe would the economical question have been allowed to prevent so grand and important a scheme from being carried out in the best way possible.

As ratepayers, suffering from the steady increase in our municipal burdens, we are, of course, grateful when the Council lays a restraining hand on the expenditure of public money, but—

"There is that scattereth and yet increaseth; and there is that withholdeth more than is meet, but it tendeth to poverty."

On such an occasion as this, the Council could not fairly be accused of extravagance, if it sacrificed something to those æsthetic considerations which have been brushed aside as if they carried their own condemnation with them. May I be forgiven if I remark that the estimated cost of the least expensive among the proposals I have described, is about the same as that of the cheap lodging-houses or shelters which the Council are about to build, and which we are told on the authority of Mr. Loch and others will encourage the loafer and spread the area of pauperism.

It is a pity when modern improvements are so contrived as to obliterate ancient lines of communication which have perhaps become historical, or at all events bear the traces of an old civic life. Sometimes they mark the growth of a town, and the accidents which attended its expansion, and it is interesting to trace the reasons for queer twists and irregularities to circumstances of ownership, or of older settlements. For instance, till Mandeville-place was cut through, not so many years ago, High-street, Marylebone, ended abruptly near Manchester-square where Marylebone-lane falls into it. It was at first nothing but the High-street of an outlying village, in Hogarth's time still so remote and semi-rural that he makes it the scene of the Rake's clandestine marriage. It was approached from London by the narrow tortuous Marylebone-lane, that then wound between green fields and hedgerows as it now does between houses. In the same neighbourhood are, or were—for it is dangerous to speak of anything in London as still existing which one has not seen for ten years—two detached fragments of what was to have been a continuous Henrietta-street, but is cut in two by Stratford-place with no way through.

This preserves the memory of a building scheme which was baulked by the refusal of an intervening owner to sell. Portland-place, again, owes its unusual and stately width not to any grandiose idea on the part of the builder, but to the condition laid upon him not to build in front of Foley-house, which stood across the southern end. The same reason probably causes that twist in Langham-place round the hotel; for Nash, no doubt, would have liked to carry Regent-street in continuation of Portland-place in a direct line had he not been prevented. These are a few random instances of local history, not perhaps very important of themselves, one might almost say trifling, but yet sufficient to awaken interest when one comes across them, and to be worth preserving when there is no serious reason for wiping them out. But the argument carries much greater weight when one comes to the consideration of the more important historical features of a town, such as the Boulevards of Paris or the Ring at Vienna, which mark the lines of the old fortifications, or the streets of London which still define imperfectly the old Roman boundaries, the obliteration of which would be a serious loss to all who care to realise the past history of the town they live in, and to trace it in its monuments and visible features.

I think then that another principle to be observed in altering or improving an old town should be that the general lines of the main streets ought to be respected whenever it is possible, and the general conformation of the plan as little altered as is consistent with public convenience. Above all, this is desirable in the case of a city that is not only old but has been the scene of great events in the history of a nation; one whose streets possess associations that would lose much of their force if our eyes no longer rested on the stage where these events were performed. In the Paris of to-day, remodelled under the second Empire, the want of historical character must often have disappointed those who visit it with memories of the past. One would willingly spare a good deal of modern splendour if one could have something of the Paris of the Valois, or even be able to trace out better the scenes of the Great Revolution. London, which has better preserved her connection with the past up to the present, having been spared the blessing of a Napoleon or a Haussmann, is now in danger of losing it rapidly. It will be a great pity if such improvements as the enormous traffic of the day demands are carried out without due regard to historical associations on one hand, and on the other to the preservation of interesting or beautiful buildings that lie dangerously near the line of alteration.

Considerations of convenience on the one hand and beauty or sentiment on the other are seldom wholly irreconcileable; their claims may generally be met by a compromise such as that which has saved the church of St. Mary-le-Strand. To shut our eyes to any considerations but those of bare utility is to hand our cities over to the Philistines. Easy locomotion from point to point is not everything. Streets are not, or should not be mere mechanical contrivances for getting to our destination as speedily as possible; they have never been so regarded at any age but our own; one might almost say they are not so regarded now in any country but this. They should be beautiful and interesting, and so disposed as to show off their buildings to advantage, and to preserve faithfully their historical traditions; and Londoners ought to be able to take the same pride, and find the same enjoyment in the streets of their great city, that the burghers of Florence or Venice, Nuremburg or Ghent, did and can still do in theirs.

One very awkward result, moreover, would be avoided if the lines of old thoroughfares were taken in laying out new ones. Everybody must have noticed the sharp triangles to which corner houses come in most of the new streets that have been driven through crowded districts of London. They are caused by the fact that the general trend of the old streets lay obliquely to the line chosen for the new ones. In the new Kingsway, now under construction, towards the Holborn end the line is fairly square with the streets it passes through, but as it comes south the streets bear off obliquely, and this unsightly result will have the usual bad effect, unless the adjoining streets are altered also for some way outwards.

But bad as these sharp-ended sites are for architectural effect, and inconvenient as they must be for internal plan—for anybody can imagine that a room shaped like an equilateral triangle cannot be a pleasant one to live in—they are not so bad as the rounded ends and corners which have been the fashion in new streets. Rounded angles are seldom agreeable in architecture, and are best avoided. They deprive one of the firm outline and positive drawing which the eye demands in builder's work, and substitute for it a certain weak indefiniteness which is

destructive of true form, and confuses the elements of proportion. Whether in large or small buildings this rounding of the mass is equally injurious. Small buildings, perhaps, need sharp square forms and positive outlines even more than large ones, and yet nothing can be less satisfactory to the eye than these rounded fronts on a great scale, as, for instance, the Grand Hotel at the corner of Trafalgar-square, a huge pudding of a building without a single firm line to define its shape or proportions.

These rounded angles are, I think, a matter of paper architecture, by which I mean that that they look well in a drawing, and have a show of convenience which is not based on practical experience. Those long easy curves, which look well on paper, are not, I believe, found to save the horses, for they mean a long bearing on one rein, which is more wearing than turning a sharp corner and having done with it. Some of us, who have been oarsmen, will remember how much worse it was to have the rudder against one round a long curve than round a shorter one, and may form from that some idea of the views a horse might be imagined to entertain on the matter. If it is ever absolutely necessary to take off an angle for the sake of foot passengers, and I quite admit that this need may occur when there are no areas between house and street, let the corner be canted off with a flat front, which will give two bounding lines at the angles. Foot passengers, however, do not run very much against one another and need never do so if everybody observed the rule of the footway. A few more direction labels—"Keep to the Right"; put up on lamp-posts and elsewhere in our crowded thoroughfares, and some insistence on the rule by the police, who I have observed always walk on the wrong side themselves, would enable us to build our corner houses with that squareness and definite outline which is one of the first conditions of tolerable architecture.

In the original plans for the new "Kingsway" all the corners were shown to be rounded off to such an extent that some parts of the street would have resembled a row of huge band-boxes rather than a street with parallel sides. We may thank the architect of the Council, Mr. Riley, for having persuaded them to modify these extravagant curves, and substitute canted angles of more reasonable dimensions.

In the case of a street that is entirely new from end to end, such as the Kingsway, it is plain that many difficlties are absent which present themselves when it is a question of altering an old one, where there are buildings that must be respected. This is particularly so in the matter of scale. The buildings that are to line Kingsway may be as large as they please; there is nothing to compare with them, nothing that they would injure by overpowering it. They will only be judged by one another, and there is nothing to confine them to any established proportion. In the case of the Strand this is not so. The proper scale there is given by the two churches and Somerset House. These are public buildings, and in every view of the street they have always predominated very happily, as they are entitled to do, over the private houses around them. Here is a scale to which on artistic grounds the new buildings must conform if they are not to spoil the picture. Unfortunately this is not likely to be a consideration with either the London County Council or the lessees and purchasers of the new sites, if one may judge by the beginning that has been made. The new Gaiety Theatre is far enough from St. Mary's to do it no particular harm, but an enormous building has been run up to a still greater height next to it which overtops both theatre and church. If this is to give the scale of the other houses that are to follow on eastwards the churches will be reduced by comparison to the size of toys; their architectural importance will be ruined, and the street view will suffer. I sincerely trust it is not too late to put some limit to this overbuilding and to induce the Council to fix a height for the Strand front which will be properly proportioned to the scale of the old buildings which give the Strand its particular charm—a charm, however, which may easily be broken by injudicious and disproportionate surroundings, Let the houses in Aldwych and Kingsway adopt a scale of their own, but let the Strand front be restricted to the scale given already by the fine buildings which will remain the greatest ornament of the street if it is judiciously laid out. There is a serious danger lurking behind the words of the report by the Improvements Committee, that "it will be possible to secure under the Council's scheme an imposing effect for the buildings to be erected on the northern side of the Strand." We do not want an imposing effect on the north side of the Strand. We want houses, lofty perhaps, but of a reasonable loftiness that will not crush the public buildings into

insignificance, nor contrast too violently with the buildings on the other side of the way. Let the imposing effects be reserved for Aldwych and Kingsway where they can have the field all to themselves and injure no one.

And yet even there I think we may express a hope that that megalomania which is one of the vices of the age will not be allowed to run riot. The sky-scraping architecture of New York is fortunately illegal in this country, but without breaking the law we can and do get nearer the sky than is agreeable to those who walk on the earth. In hot countries where the sun is an enemy to be shut out, narrow streets between lofty houses are reasonable. But in England the sun is a visitor who never or very rarely outstays his welcome, and we want as much of him in our streets as we can get. The houses of Regent-street and Oxford-street, and of the untouched parts of the Strand, have always seemed to me of the ideal height for our dim, murky London climate. Those streets always look bright and cheerful, while, for sombre melancholy and awful gloom, I know nothing to approach Victoria-street, Westminster, with its monster mansions on either side.

As things are however at present, it seems that those who build along the new frontages will be allowed to do much as they please in the matter of height and style. The only condition is that they shall submit their designs to the London County Council, who it is supposed will form a committee of taste to pass or reject what is shown them. This suggests another question as to the best way of laying out street architecture on a general scheme. Should it be treated as one whole—a single design to which every builder of a part must conform, or is the building line to be the only rule to which everyone must work, all else, style, scale, and architectural treatment being left to the individual taste of the several builders? Is the architecture of the street to individual or collective, accidental or regular? There is much no doubt to be said for either alternative. If we recall to memory the streets that have delighted us above all others in our travels, I fancy the picture that will rise in the mind's eye of most of us will be the street irregular, winding perhaps among the magpie black and white houses of Shrewsbury, or the carved and overhanging timber fronts of Hildesheim which seem almost too quaint to be off the stage of a theatre; or the High-street of Oxford, with its stately series of colleges and churches set off by the more modest buildings that serve as a foil to their beauties; or the arcades of Bologna and many an old Italian city; or the shadowy eaves of Berne and Lucerne; or Lisieux with its slated house fronts; Caen and Rouen; or such streets as abound in the old cathedral and county towns of England, with fronts of mellow brick or hoary stone, and here and there a glimpse of a trim garden or masses of foliage from overhanging trees—these are the streets we love and of which we cherish the memories rather than the formal splendours of modern improvements. But these streets that we love are not to be had for the asking. They are the outcome not of design but of accident. They are the creation of individualism, of each man's desire to house himself according to his own taste, and so each house has in its degree an historical interest. The result is not so much architectural as picturesque. The Strand of three or four years ago was, and the western part of it still is, a street of this kind, eminently picturesque, deriving its interest from variety of colour, skyline, and height, all combining when seen in perspective into a certain agreeable confusion and intricacy of detail that was pleasing, although when one came to examine the buildings severally, except the few that had survived from the 17th or 18th century, there was hardly a good one among them. Such a street cannot be designed, it must come of itself, and it requires time and weather to ripen it to perfection.

But the new Strand cannot wait for time and weather; the buildings along the new frontage have begun to rise and will continue to spring up with magic rapidity. The north side of the street will soon be lined with buildings of some kind or other, and the question is whether they should be drilled into regularity as was done in the case of Regent's-street and the terraces on Crown land facing the Mall and those in Regent's-park, or else be left to the individual taste of the owners, subject only to their satisfying the taste of the County Council. The latter is the plan proposed at present, though perhaps it is not too late to revert to the other should it be thought desirable. I confess to regarding the unrestrained or practically unrestrained genius of the commercial architecture of to-day with misgiving. If we may judge by what is now going on in the Brompton-road the result will probably be a competition in which every house will try to outshine its neighbours by cramming on more ornament, overpowering

it in splendour, and overtopping it in height. Better far than this the monotony of Gower-street or the unloveliness of Wimpole-street—but the days for sober building of that kind it is to be feared are gone for ever. The tide of self-advertisement is rising; it has risen high enough to capture the last stronghold of journalism, and it has laid nine-tenths of our architecture at its feet. It is held that architecture to be good must be smart; art is supposed to consist in ornament, and ornament is valued in proportion to its quantity not to its quality. Nothing has done more to help this principle into practice than the introduction of terra-cotta as a building material. After the first cost of the model, it is as cheap to cast ornamental work as plain, and as the ornamental work makes more show for the same money, there is no end to its abuse. To the fatal facility afforded by this dangerous material we owe the trimmings round door and window which have violated the respectability of Russell-square, the unspeakable gorgeousness that disturbs the repose of the purlieus of Berkeley-square, and the elaborate arcades and great dome that seem to ride insecurely on the edge of plate-glass windows in the Brompton-road. It is a great pity that terra-cotta should have been so misused. Properly employed as it was in many towns of North Italy, notably at Cremona and Pavia, and in the fine roundels at Hampton Court, or the tombs at Layer Marney, terra-cotta is a noble material, and when glazed it may rise to the dignity of Robbia ware. But cheap repetition of ornament vulgarises it; when once used the moulds should be destroyed except in case of simple mouldings, or such conventional embellishments as the egg and dart, or dentils, and such like simple ornaments which alone admit of repetition to any extent without awakening feelings of fatigue and disgust.

But the mention of plate-glass reminds me that I have scarcely time left to speak of what is perhaps the crucial difficulty of street architecture, namely, the shop window. In this age of display and self-advertisement, when commercial modesty would seem to have fled like Astræa to the heavens, it is thought necessary to abolish the front wall of the ground floor, and substitute huge sheets of plate-glass behind which the wares can be exhibited in lavish profusion. There are a few exceptions, but very few. I suppose a tailor who broke out one of these large windows and displayed his wares instead of the usual wire blind would lose his customers; and now and then one finds a shop deliberately retaining the modest window and small panes of 50 years ago, and I think one always feels instinctively that the wares in that shop must be above average. But the rule is the other way. These open shop fronts have come—as the slang phrase goes—"to stay," and architects will have to reckon with them just as the sculptor has to reckon with the modern trouser and frock coat, which cause him equal distress and perplexity. Accepting, then, the great plate-glass ground floor as inevitable, how are we to treat it architecturally so as to make it tolerable, or if possible more than tolerable, actually an element of beauty in the façade? For it ought to be possible to do this if it is one of the glories of architecture, as we believe, to accommodate itself to circumstance and necessity, and not only to construct suitably but to satisfy the eye and give pleasure by expressing the conditions of the construction.

This, then, is the problem. The ground storey must have no front and no partitions and no supports except against the party wall on either side; but the upper storeys must be enclosed for habitation and be divided by partitions into rooms. The whole mass of this upper part, sometimes of enormous height, has to rest on an iron girder at the ceiling level of the ground storey, a girder which has no supports but an iron stanchion at each end. How are we to treat this on the orthodox principle that architecture should be the expression of the construction, when the real construction of such a building has so little with which to appeal to the eye? It may of course be argued that the old construction with piers and arches satisfied the artistic sense and pleased the eye because we knew from experience that it was sufficient for support, and that when we find from experience that two steel stanchions and a beam across them will do as well, our artistic sense will or should adapt itself to the new conditions, and rest equally satisfied in them. This is no doubt a hard saying, but yet there is truth behind it. To bring this construction within the domain of art it is only necessary that it should be visible. What support there is must be seen, for art only deals with what meets the eye. It will not satisfy the artistic sense to know that the support is there unless it can also be seen, and then the eye, appreciating the difference between the properties of iron and those of brick and stone, may learn to be satisfied, and admit the novel construction

into the domain of art. There seems no reason why the stanchions and bressummers should not be shown and treated architecturally. But so far from this being done now, the practice is to hide them carefully as if there were something disgraceful in being obliged to prop the upper storeys, and the necessary columns or stanchions are either concealed behind stone facings to give a fictitious appearance of stone construction, which, if real, would be wholly unequal to its apparent duty, or else they are encased in mirrors which prevent their being seen at all. So long as the building appears to be supported on the edge of its plate-glass shop-front its architectural redemption is past hoping for.

The same inconsistency prevails in the upper storeys. The solid lower storey is done away with to suit a novel requirement. But the builder puts above it just the same upper storeys that would have been there if the lower part had been built in the old way. This cannot be right: so radical a change in the supports ought to affect the character of the whole elevation. We cling to the old traditions in one part though we abandon them in the other, and the result is ludicrous when it is not offensive. What can be more ridiculous than the oriel window we often see insecurely balancing itself on the middle of a girder? These features belong to the old way of building, and have no place in the new. Till we recognise this and make up our minds that if we accept the new mode of construction by iron we must break definitely with the traditions of brick and stone, there will be no hope for us.

The best solution I can suggest is that as the lower storey must be of iron construction the upper storeys should be so too, as far as is consistent with their purpose. To manage this we must start with a full recognition of the difference between the properties of iron or steel and those of stone or brick. The strength of masonry or brickwork, setting aside the cohesion of mortar which should be regarded rather as an accessory, consists in its weight and its resistance to downward crushing loads. If exposed to lateral force its stability depends either on its *vis inertiæ*, or on the equilibrium of forces acting in opposite directions. It has no tensile strength and no elasticity or very little, and the only lateral tie it has to depend on is that of the bonding or interlacing of the stones or bricks that compose it. Contrast this with the methods of carpentry. Timber construction has all the properties that are wanting in masonry or brickwork. It has tensile strength and elasticity, and it can be framed so as to tie the fabric securely together. Good carpentry hangs together by its joints and framing, and will submit to considerable distortion before it gives way. The half-timbered houses of England and France afford many instances of this: they are often out of the perpendicular, leaning forward, falling backwards, or inclined sideways, and yet, so long as the timber is sound and the tenons hold, they remain secure.

This half-timber construction, be it observed further, is a reversion from arcuated construction—it is in the literal sense of the word a *trabeated* style—a style of posts and beams, quite as much so in its own way as the Parthenon and the older buildings that preceded it, and reproduced in stone the elementary forms of wooden construction.

Now, in these half-timbered houses I think we may find a suggestion of what might be done in the way of construction with iron and steel. Iron construction, after all, is very like carpentry. It is a trabeated style. It has the tensile strength, the rigidity, and the elasticity of timber, but in a superior degree, and it hangs together by its joints, cleats, and bolts, much as carpentry does by its tenons and mortices. Just as the half-timbering forms the skeleton of a Surrey cottage or a Shropshire mansion, which is filled in with the flesh and skin of brick nogging or cob and plaster, so might a skeleton of iron framing contain a similar wall-veil or curtain to make the interior of the upper floors habitable.

Let us imagine, then, the street front of a row of shops below with several storeys above. The supports of the great bressummer would be exposed to view, made preferably of cast-iron, and between them, not as now in front of them, would be the great plate-glass screen enclosing the shop. The bressummer itself would also be exposed to view, protected by some salient feature to throw off the wet, and thus the eye would be contented by the exhibition of the supports. The upper storeys would be formed by a skeleton of iron or steel, filled in with brick or stone, but showing itself on the surface just like the half-timbering which was its precursor. The strength of the building would consist in this framing, and the filling in might therefore be only so thick as was necessary to secure an even temperature in the rooms. Probably two four-and-a-half inch walls with bonders and a hollow space

between would suffice, the inner lining being contrived so as to cover the iron frame and prevent mischief from condensation. The interior partitions would, of course, be formed in the same way and the floor would naturally be constructed of iron and concrete. Following again the precedent of half-timbered houses, the upper floors might be made to overhang by projecting the joists of each storey successively beyond the face of that below. In this way I can conceive an admirable effect being produced. The filling in might be either plain or modelled with plaster in relief, or faced with glazed bricks or coloured terra-cotta, or decorated with sgraffito, or treated in a dozen different ways suitable to the embellishment of plain surfaces, for let us hope there will be no oriel windows hanging in air, nor any fantastic freaks such as we are now suffering from.

M. Viollet-le-Duc in his lectures on architecture — lectures which, like the Verrine orations, were written but never delivered—has several sketches for construction with iron supports. Some of them are suggestive but the majority seem to cling too closely to the Gothic art he loved, to be pleasing in combination with the new principles he is advocating. Gothic vaults of masonry, springing from stone capitals which have no columns below them, but are supported by inclined struts of iron projecting from a distant wall, do not impress one favourably, nor does there seem any object in retaining the Gothic vault at such a sacrifice. But he shows a street front constructed somewhat in the manner I have described, which commends itself at once as sensibly contrived.

Whether or no anything of the kind has ever been built I cannot say. It seems to me an experiment that it would be most interesting and instructive to carry out.

Whether this iron construction will prove durable or not is another question. One has been told that the life of a girder exposed to changes of temperature is not more than that of a generation. It depends a good deal on the thin skin of paint that protects it. What will happen in the inside of box-girders that can never be painted remains to be seen. What will happen in case of a great fire is also a grave question. But after all, these buildings are not intended for immortality; if they last for a generation it may be enough. The constant changes that London undergoes make doubtful the permanence of anything one does. A house I built in Dover-street some seven or eight years ago has been already pulled down to make way for a station on the Tube railway. The great mass of Walsingham-house, just destroyed, and about to be replaced by a monster hotel, had only enjoyed a life of some 20 years. It fell to my lot to demolish an expensive marble staircase and entrance hall of one of the city Companies which had only been built thirty years. Thirty years hence the new marble staircase I made in another part of the building will perhaps follow its predecessor into oblivion, and the city Company itself may conceivably have ceased to exist. The changes in London are so incessant and of late so sweeping that he would be a bold man who would prophesy a long life to any building in it whether old or new. The number of Sir Christopher Wren's fine city churches is being diminished. One by one they are being pulled down and their sites covered by banks and offices. Huge piles of chambers cover what ten years ago or less were the pleasant retired gardens and courts of New Inn and Clement's Inn, and Clifford's Inn is doomed to a similar fate. If these monuments of architectural and historic interest are unable to save themselves why should we expect or wish for the ordinary shop front more than an ephemeral existence?

But though street architecture may be evanescent, the streets themselves—at least the more important of them—will probably continue to run on their present lines more or less, and if, as now happens, any great innovation has to take place it is important that the new lines should be properly laid down. When one considers the enormous cost of altering the Strand, it is not likely that it will ever be altered again for centuries, and I would once more express a hope that the success of the new plan may not be imperilled by any misplaced economy. It may not be too late to persuade the London County Council to reconsider the decision in favour of their original frontage line and to place some restriction on the scale of the new buildings facing the Strand. Possibly the important society I have now the honour of addressing might bring its influence to bear on the matter. Æsthetic considerations after all do go for something though they are lightly esteemed by the Improvement Committee. Never was there so much talk about the advancement of art and art education. Art schools cover the country, national prizes and scholarships are showered on the students, and we shall surely stultify ourselves if, when the time comes for putting

our pretended interest in art to the test, we choose the worse way of doing an important work instead of the better from purely utilitarian motives.

The SECRETARY of the Section read the following letter from Mr. Walter Crane:—I should have liked to have been present at Mr. Jackson's lecture on Street Architecture — a subject which in the present state and transformation of London one would think must claim universal attention. We seem to be in a terrible fix. The appalling cost of the ground in London, owing to our having allowed private owners to reap the fruits of the community to which it owes its value, stands in the way of really drastic improvements, and makes the struggle with London traffic almost hopeless, and the effect of our street architecture dependent upon such clearances as can be made to relieve the congestion of such traffic. The policy of huge stores and flats upon the top of plate-glass walls knocks everything else near them out of scale; while posters and mammoth lettering for commercial purposes make even the best efforts of the street architect look ridiculous. We have tasteful and capable architects among us, but somehow their influence is not so great as it ought to be, and even their efforts are liable to be stultified by the commercial monstrosities alluded to. The great fire of 1666 gave Wren his opportunity. The great clearances of the London County Council ought to give our best modern architects their opportunity, but our chance of gettting really beautiful buildings or streets seems quite haphazard under our present system. Why should not every municipality have a council of advice on architecture and street arrangement?

DISCUSSION.

The CHAIRMAN said he thought the great problem was to impress upon municipal bodies—of course, primarily in London, but also over the whole country generally—the importance of æsthetic considerations which were now so much neglected. From his experience of various municipal bodies, he thought one of the great difficulties was that the work of the municipality was necessarily very hard and very tedious work, and it wanted a certain class of men to do it. Unfortunately one did not often find the æsthetic perceptions combined in the same individual with that sort of character which would lead that individual to go day after day to his county or town-hall, and toil over committee work. He thought that was the real point. He did not think as a rule the municipal bodies fairly represented the taste of the nation. By a process of natural selection, they might be said to represent what was somewhat below the average taste of the nation. A great deal was heard about art nowadays, but, in his humble opinion, not nearly enough importance was attached to architecture as an art. Too much time was spent over drawing and painting without considering architecture. He had long considered that the glory of architecture was that it was the poor man's art. The exterior of a fine building was equally visible to all, and, moreover, it was a lasting art: the average duration of a building was at least two or three centuries. Other works of art as a rule were inaccessible to the public, and only to be seen on special occasions. Architecture was in every respect a most difficult art. That, he thought, was evident from the number of architects who did not succeed conspicuously in their profession. It was extremely difficult for the amateur to acquire sound ideas upon the subject, however much he might desire to do so, and it seemed to him that that was a great gap in English education. If architecture were more taught, especially in association with history, and if it was taught in connection with such elementary teaching of art as was already in existence, people might have better canons of art. The author in his paper said that people did not know what was good art and what was bad, and until they did know what was good and what was bad, it was hopeless, he was afraid, to expect them to do what was good. The most hopeless thing to his mind in the present day in town architecture was the height of buildings. At the same time, looked at in the spirit of compromise, he did not see the slightest hope of restricting buildings to a lower height than that allowed now by law. As they knew, a limitation was imposed not very long ago. The great cost of land, and the great desire of everybody to be as near the centre of town as possible, made that inevitable. London was not so bad as New York. He was afraid that poor St. Mary's—he was pleased to have been connected with the preservation of the church—would be smothered by the imposing structures on the north side of the Strand, when the County Council succeeded in selling the land, but even that would be nothing to the fate of Trinity Church in New York, which stood between two skyscrapers, and could not be discerned unless one was right opposite it. As a general rule, the fates were on the economical side rather than on the side of doing the thing well. There was one point to which the author did not allude, although he knew that he recognised it, viz., the constant warfare that was waged against the best buildings of the architect by the bill-poster. There had been two widenings in the Strand, and anyone going through the Strand, and looking to the east or west, would see at the widening that the blank ends of the adjoining buildings were covered with advertisements, which always suggested that the building was not finished. He saw a member of the Improvements Committee present, and that gentlemen and himself endeavoured to purchase one of the houses, but unfortunately it was a public-house of enormous value, and the owner of the house persisted in sticking advertisements upon the wall.

Sir John Wolfe-Barry, K.C.B., F.R.S., said he found himself very much in accord with all the author had contributed to the question, which was one of great importance. He thought the time was very opportune for the matter to receive public attention, because, as most people knew, there was a Royal Commission sitting upon the question of the congestion of traffic in London. He thought anybody who read the evidence given before that Commission would realise that whatever might be said about the necessity for better modes of locomotion, the broad fact stood out conspicuously that the streets of London were inadequate for the traffic which they had to accommodate. Some people seemed to think, and he rather fancied that that was the trend of the evidence given by the police, that the traffic should be made, by a variety of restrictive regulations, to fit the streets, but he did not think that was the reasonable thing for a great city. The streets ought to be made suitable and adequate for the traffic of its inhabitants. In all probability, dating from something like the present time, there would be a great effort made to make new and wider streets in London to fulfil the object which was now most urgent, and which could be assessed, even in a money point of view, as entailing, from the narrowness of the streets, an enormous loss to those who daily frequented them. It was interesting to see that the money loss, such as it was, fell more particularly upon the wage-earning class, and it is to be remembered that they formed the class of all others to whom time was money, more so perhaps than to even the middle classes of the community. That being the case, it seemed to him highly probable that large street improvements would be the order of the day; and it was most desirable that the street improvements should be considered in an artistic as well as from a utilitarian point of view. He did not know that he would go quite so far as the author in saying they should consider the artistic point of view first. He thought the great point for a new street was that it should adequately accommodate the traffic in the direction which was most convenient, and he had not the least doubt in the world that the modern architects would rise to the occasion just as the older architects did, and would deal with the problem which they had to solve, the main lines being more or less prescribed as matters of necessity. In that connection he most cordially agreed with the great desirability of considering the question of vista, and the grouping of streets and public monuments. He thought that had been much neglected in London, with very great disadvantage. The only real effort historically in that direction was the valuable work of Nash in the laying out of streets in the time of the Regency. There was some attempt made then in making the street point in a direction which was agreeable, and in placing public monuments where they could be seen in proper directions. When they came to consider the more immediate question of the paper, the modern style of street architecture, he could not help thinking that the architect of the future must discard a great deal of what he had been taught of Grecian, Roman, and Gothic architecture, which only fitted special buildings, and was not suitable for the commercial life of the present generation. Just as the freer style of architecture took the place of the more cramped style in former times, so in his humble judgment the modern architect would have to study steel and iron construction, and show them how it could be made artistic. He was, from the point of view of taste, one of those benighted persons called civil engineers, and, therefore, he would not express any opinion upon what was artistic and what was not, but he was quite certain that the architect of the future must make steel and iron work to serve his purpose as an artist. Thus he thought it was most valuable to hear what the author had said on what he called the trabeated form. It carried the germ of what he (the speaker) had in his mind, which was a development of structural steel and iron work to produce a harmonious whole, and for himself he did not see why that should not be the case. They knew that very beautiful things could be done in steel and iron construction. He always admired extremely Southwark-bridge, which was a building of a most bold conception made of cast-iron. He thought it would be very difficult to improve on some of the lines of general beauty of Southwark-bridge, and he could not see anything but encouraging results in Blackfriars-bridge, the great arches of which were, in their way, quite as beautiful as a stone arch. If it was right to discard the idea of stone construction when stone limited the span of arches in a way that was inadmissible in their work, why should not it be right to adopt the same idea in the design of domestic architecture? A shop window was a necessity of commerce; if that was recognised—and he did not think anybody for a moment could doubt that it must go on—the trabeated form was the form which could best adjust itself to the conditions. How that was best to be done was a matter which he thought could be left to the best architectural talent of the day. That was the problem that had to be faced, and he was quite certain it could be faced by persons of the attainments of Mr. Jackson, and other architects who gave their mind to it. He could not help thinking that architects up to the present time had been too much the slaves of construction based upon materials which were no longer capable of fulfilling the work of modern requirements. Until they shook themselves free of those fetters, people would always be confronted with bastard styles of construction, which were ludicrous in themselves and did not satisfy the eye as to strength or fitness. He recollected the navies of the present day being quoted as an example, and remembered when people said nothing could be more hideons than the modern iron ships. But they had come to stay, and, to his mind, apart from the sails of former times, the hulls of the modern ships

were quite as beautiful as the old wooden ships which they had replaced. He did not mean to say that two or three funnels on a ship were as beautiful as a cloud of sails; but when one got rid of the idea of a sailing ship, the hull of a modern ship was every bit as beautiful as the hull of an old three decker. He thought everybody was much indebted to an architect of the distinction of Mr. Jackson for coming and telling them so frankly that what was to be done was to deal with the necessities of commercial architecture. It was a new departure, he thought, in architectural discussions. It seemed to carry with it the ideas which they ought to follow, namely, that it was perfectly hopeless for architects any longer to consider that they could make commercial requirements fit the architectural knowledge of 200, 300, or 500 years ago! Iron construction was the construction of the future. It had so many advantages that it was not likely to be set aside, and he thought it was most encouraging that Mr. Jackson should have indicated, however slightly, the way in which he would deal with what he called the trabeated form of architecture, and so render it possible to adopt sound idea of proportion and detail to the comparatively modern building material of iron and steel.

Mr. REGINALD BLOMFIELD said that as a member of the humble profession of architects he had been particularly edified with Sir John Wolfe-Barry's remarks. Architects knew that their shortcomings were very considerable; they were used to being lectured, and even sermonised, by eminent engineers, and were very grateful to them for it. He was very glad to hear what engineers expected of architects, but he could not precisely follow Sir John Wolfe-Barry in one or two of his remarks, because he pointed out that iron and steel should be of trabeated construction, and then stated that he could not see the difference between the iron arch of a bridge and the same arch in stone. There seemed to be something wrong there. Then again Sir John asked architects to show how iron and steel were to be treated in an artistic way, but surely that was the engineer's business. Architects were waiting for the engineers to show them how they were to deal with iron and steel, and they would be only too delighted to follow their lead. He was grateful to the Chairman for having made some appreciatory remarks of the profession of architecture; he realised that it was a profession which had a good deal to think about, and which ought to be consulted more than it was at present. The subject of street architecture was a very important one, which had apparently been very little studied in this country; in fact, the public seemed to be altogether indifferent on the matter. The author had formulated three very valuable principles in regard to the method of dealing with the proper principles which regulated street designs, the first concerned the designers of houses and buildings in streets, and the other two were addressed to the authorities who controlled the designer. The first principle he termed very happily the principle of architectural comity, which was a point that all architects ought to lay to heart a great deal more than they did. There had been some glaring instances lately of the total disregard of adjoining buildings with disastrous results. He did not think any artist, if he seriously considered the matter, would entirely ignore the setting of his building, and he thought it would be unsportsmanlike of him not to consider the interests of adjoining buildings as well. The difficulty was, who was to control the man. If there was a committee, or even a Ministry of Fine Arts, they were not much more than a stalking horse for the professional man behind them, and he did not think there was at the present moment in England a sufficiently established authority on the standard of taste to warrant the establishment of such an artistic ministry. In France, where such things were done much better than in England, the great superiority was due to taste, which dated back many years. There was nothing of the sort in England, and he was afraid that all they could do was for individual designers to appeal to architects themselves. The other two principles which the author formulated were, first, the principle of vista, and, secondly, the conservation of places of historical interest. He thought they were both excellent principles, but did not think they were quite compatible. The author had given an interesting example of how the house at the end of Portland-place prevented the continuation of Regent-street right through to Portland-place. What was wanted was some definite principle of the designing of the streets. There was no doubt that streets could not grow; they had to be designed and laid out, and it seemed to him that the proper principle to control them was really the æsthetic one, *i.e.*, architectural and artistic considerations, of course after utilitarian purposes had been satisfied. In order to obtain that there must be some controlling spirit. The author had congratulated the London public on never having had a Haussmann or a Napoleon. He did not agree entirely with that, because some such spirit as a Haussmann was wanted if a great vista was to be obtained, and Napoleon cleared the way to a large extent for the very stately city which Paris was at the present day. There was no such thing in England, and the authorities did not seem to be conscious of the possibility of it, and it was to that they owed such horrible fiascos as had distinguished the work of the London County Council. Northumberland-avenue appeared to have been laid out so that the eye settled on the signal posts and the lamps of Charing-cross bridge! He hoped better things would come out of the Strand improvement than had happened so far. The difference would be seen if such undertakings were compared with those carried out in Paris. In the Place de la Concorde there were grand views on

all sides. In the Place de la Opera, although he did not admire the Opera House, he admired the way it was placed. Then the very fine new bridge, "Alexander the Third," had been laid with direct regard to the Invalides at the end of it; and was one of the finest things in Europe as a piece of municipal architecture. It was not only a question of placing the things, but spacing them, and in England there was no idea of scale at all. He thought the biggest square in London was Russell-square, and a terrible affair it was at present. The biggest public parade in London, apart from the Horse Guards Parade, was Trafalgar-square, and compared with any of the famous 'piazzas of St. Mark's, or St. Peter's, or Milan, it would be seen what a rubbishy affair it was. He thought the corner of the crescent in the piazza at Milan was about 500 paces, whereas Trafalgare-square was the same in feet, which showed how deficient England was in that respect. Another instance was the City-square at Leeds. There was a figure in the middle by an eminent sculptor, and around it many charming figures holding lamps; there were four statues exceedingly well done, but the whole effect was stultified by a poor sort of balustrade of Aberdeen granite quite out of keeping with the rest of the monument. The real gravamen of the paper was that such things were left to people who had neither time nor ability to study them. The author had described, with a great deal of quiet humour, a really touching surprise of the London County Council that the church of St. Mary-le-Strand had some architectural merits, and he also described the very agreeable candour with which they amended their decision in regard to it. He hoped that might be a sign of better times, and of some awakening intelligence; he hoped the paper would rouse them up to a keener sense of their duties as the guardians not only of the pockets of the ratepayers, but also of the beauty of the city in which they had to live.

Mr. J. J. STEVENSON thoroughly agreed with what the author said with regard to Piccadilly-circus, where so beautiful and regular a scheme was turned into an amorphous fiasco. It seemed to him that had arisen from those who laid it out endeavouring to make the most curved lines so that a cab should have no serious turnings to make. Another thing which he thought those who laid out streets placed more stress on than was necessary wes that the widths of the streets necessary produced a good architectural effect. After all people walked on the ground, and what was required was that the size of the streets should be in a sense proportioned to the size of the building. In laying out streets a great mistake had been made through the mania of making them perfectly straight. Straight streets always produced the most dreary effects. All the beautiful old streets of the world had been erected, not in a straight line but curved, and one reason why that produced a better effect was that the buildings were turned towards the onlooker. That was most noticeable in Venice, where not only the buildings were turned, but where they were separated from each other by narrow canals, so that each building had a side as well as a front. He believed that was one reason why the author very properly said that the old Strand, with its comparatively poor buildings, produced a great artistic effect. It might be difficult nowadays to have other than high buildings in streets, where considerations other than artistic beauty applied, but one hoped that, at least in the country, they would have been allowed to make buildings which were picturesque as well as convenient. He thought one of the great calamities of recent times had been that, almost all over the country districts, the new municipal laws were importing into quiet country districts what were really little bits of the mean streets of London.

Mr. T. BLASHILL said that Mr. Blomfield had confirmed what he himself thought, namely, the difficulty of laying down any new principles unless they were permanent. In his experience taste had radically changed every 20 or 25 years; there was no kind of permanence about it. He never heard of the picturesqueness of the Strand until quite recently; it was never thought of until quite modern times. The author had deprecated the alterations which were made in Harley-street. He called to mind some 40 or 45 years ago the howl of derision with which a company of gentlemen, in such a meeting as the present, received Mr. Beresford Hope when he spoke of the architecture of Harley-street and Upper Baker-street. Nothing would induce him to live in Harley-street; it was a narrow and gloomy street; and even if the whole of it were rebuilt and made as lively as the author feared, it would not come up to his scale of cheerfulness. The author had spoken against terra cotta and oriel windows. He remembered when terra cotta was looked upon as the coming salvation of architecture; everybody rushed for it, and it was simply the impossibility of getting the material within six or eight months that prevented the whole of the buildings of London then in course of erection being built in terra cotta, and now Mr. Jackson was discouraging it! Then the author had said that consideration should be given for neighbouring houses. Of course, they all liked to be polite, but he did not think any of the buildings which they admired, whether old or new, had been dictated to any great extent by consideration for the neighbours. That very fine building at the corner of Pall Mall and St. James's-street, the Alliance Bank, a rich building, not only in its outline but in its decorative features, seemed to him to have been dictated not very much by the architecture near to it. The author was in favour of designing neighbouring houses to accord with a particular structure. One instance of that was the bridge at Conway, and the imitation of the Castle, which most people would wish was not there, so that there was something to be said on both sides. With regard to the Arch at Hyde-park Corner, he would say ten times

as much as the author if he could on that subject. If he remembered right, that piece of business was arranged by the Commissioner of Works without much appeal to public taste. They heard one day that it was going to be moved at a cost of £10,000, and he thought most people wished that the arch had been kept where it was; in fact, it was worth £10,000 to put it back again. The author had raised the question of individualism and collectivism. He was strongly of opinion that individualism was likely to prevail in the future, and he thought it ought to. People who spent money on buildings would not spend it to please the municipalities; in fact they were not very anxious to take public advice at all. If the public wished elevations to be made to suit them they would have to pay for it in some shape or another. The Holborn-viaduct was begun with the intention of making everybody build to one design, but owing to the restrictions the land was not built upon for some years. The same thing happened with Northumberland-avenue. People were not anxious to take such property. He wished to make a few remarks about the method of getting rid of land for building purposes. It was now let by auction. When land was let by auction to a person, even although his plans had to be approved, there was a limit of time in which one could reject his attempts to make a decent design. In the case of the streets which Mr. Blomfield had mentioned, there was great anxiety on the part of the public authorities to get the ground covered. One could not confiscate the man's right which he had obtained by buying the land at auction; the land would have to be sold or let again, which would mean delay, and probably it would not sell at the same price as before. Why should not the authorities in London, if they desired to have control, make it clear that they had certain plots to let, and wanted a certain amount of money for them? If that were done an entirely different state of affairs would arise. Under the old style a certain set of architects made it their business to get hold of the land, and whoever wanted to build on it must get the land through them and adopt their designs. He thought that was the root of the difficulty. If the plan which he suggested was followed any man who wanted a plot would go to some well known architect, get a good design at no great expense in order to show what he meant to do; he would then go with that design to the County Council, and say he would give so much for the plot, and show the sort of building he intended to put on it. In that way the design would be seen before the bargain was made. Under the present system the thing was settled in the auction-room, and then a fight began between the Council and its tenant.

Mr. HALSEY RICARDO exhibited a diagram which expressed his views on the principles on which one might construct a street, showing some of the possible advantages of the trabeated style of iron and steel work. The overhanging of the upper storeys would give shelter to the ground floor. In order to get a wide street, the upper parts of the building would be set back in order to let more air in. The people in the residential rooms on the top storeys would have a little forecourt, which they could use for observing what was going on in the street below. The real object of the diagram was to show how the difficult problem of the question of the traffic might be solved. In the roadways, provision would be made for vehicles of two speeds, quick and slow, and the rule of the road would be strictly kept to. The same provision was made on the pavements. There were two classes of people who used the streets, business people who get along as quickly as possible, and a second class who desired to walk slowly and look into the shop windows without being jostled and hurried. Provision was made for those two classes of people on the pavement in exactly the same way that provision was made for fast and slow traffic in the road.

Mr. MARK H. JUDGE was very glad the author had referred to the Strand improvements at some length, and finished his paper by expressing the hope that something would be done to induce the County Council to alter the line of frontage. He agreed with Mr. Blashill that some alteration should be made in the method of the disposal of land by the County Council in connection with the great improvements which were being made. There was evidently something wrong when land in that central situation, perhaps the principal thoroughfare of London, remained unsold and unoccupied for a long period, and it was not in the public interest that that should be so. Efforts ought to be made to cover that land with buildings in the quickest possible time, and he thought it would be a very great advantage if some steps were taken to force on the London County Council the suggestion made by the author.

Mr. BLASHILL said he did not take upon himself the responsibility of advising a change in the system, except if the Council desired to retain the kind of control Mr. Jackson and many others wished to have over the elevation.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Jackson for his exceedingly able and interesting paper, thought Mr. Blashill's suggestion was a very pregnant one. He thought the suggestion made that land should be sold subject to the condition that the buildings erected were designed by a well-known architect would get over the difficulty quite easily. That system was adopted by the Duke of Westminster, with very satisfactory results.

The resolution of thanks being carried,

Mr. JACKSON, in reply, said there was a good deal he would like to say in reply to the gentlemen who had addressed the meeting, but as time was short he

must necessarily curtail his remarks. He thought the question of iron construction should be taken very seriously into consideration by architects. He was delighted to hear what Sir John Wolfe-Barry had said as to the necessity of abandoning the archæological way of looking at architecture, which not only on that but on many other grounds was the view architects were coming to themselves. The time had come when they must face the new conditions, and try and adapt their architecture to them, in the first place, considering that people in former days built buildings in a style which was very likely entirely unsuited to present necessities. With regard to what Sir John Wolfe-Barry said on the subject of abandoning the old styles, he had been much struck with the remark that they ought never to be afraid of showing the iron construction. He once had the privilege of going under Sir John's magnificent Tower Bridge when it was a naked structure of iron and steel, before it was disguised with the stone, and he was immensely struck by it. It seemed to him that was a new departure, not only in engineering but in architecture, and he believed he was right in saying that, among others, Sir John regretted when it was masked by the superstructure of stone which now disguised it, and gave it the fictitious appearance of its being supported by pillars of masonry, which would be utterly inadequate to the task they fulfilled. The iron structure should be visible, and should not be treated as if it were something to be ashamed of.

CANTOR LECTURES.

MUSICAL WIND INSTRUMENTS.

By D. J. Blaikley.

Lecture I.—Delivered November 28th, 1904.

Music stands in a unique position among the fine arts in this respect, that the conception of the artist obtains its realisation to a very large extent, by means of the mechanical arts and sciences, without which all music would necessarily be limited to the voice. In this characteristic it differs widely from poetry, which is absolutely independent of the knowledge of any designer, or the skill of any craftsman in dealing with the properties of natural bodies; it is more nearly allied with architecture, for as the architect has to consider how far the beauties of form and proportion which may present themselves to his mental vision are consistent with the properties of the materials at his disposal, so also has the musician to adapt his work to the instruments by means of which it is to be rendered, and to bear in mind not only their different qualities and mechanical peculiarities, but also the limitations they severally impose upon his executants. And it may be suggested that in proportion to the extent that the existence of these limitations is realised by the composer, so will he be able to produce work which will impress the hearer as being bound only by the laws of artistic beauty and fitness, and as being altogether unfettered by mechanical necessities.

This condition under which the musician labours has its counterpart or reflection in the work of the instrument maker, whose province it is to minimise to the utmost the impediments placed in the way of the artist by the mechanical nature of instruments: so that the æsthetic or psychical impression to be conveyed from the mind of the composer to the audience through the language of music, shall not be unduly weakened by difficulties in the way of the executant musicians. The ideal condition is that the player should be left free from all thought of mechanical work, or of forcing particular notes or intonations foreign to his instrument: the instrument should be in his hands so entirely responsive to every impression as to place him as nearly as possible in the position of the singer in the use of his vocal organ. Deliberate design to this end implies a knowledge both of the physical laws of sound and music, and of the physiological conditions ruling the technique of the fingering, handling, or blowing of an instrument, and such design is of comparatively recent date. The unsurpassed excellence of Stradivarius in his violin work, however, shows how much may be achieved by careful observation and experiment, ruled, perhaps, by a certain intuitive perception, approaching in character to an artistic faculty.

For ages, the art of musical instrument making was chiefly directed by the "rule of thumb," tempered by the application of the results of accumulated experience, and illuminated from time to time by the genius of men who, though ignorant of the physical principles underlying their work, yet had that artistic intuitive perception just referred to. When it is borne in mind that it is only since the date of Prof. Helmholtz's investigations that there has been any clear understanding of the nature of tone-quality, this state of things cannot be wondered at; but with the spread of the knowledge of acoustics, the art of musical instrument making is gradually becoming a branch of applied mechanics. It would be going much too far to say that all that is comprehended in the term "music" can be

explained by mathematics, for the principles of no fine art can be thus demonstrated, yet it is true that individual musical sounds come within the scope of measurement, and it is recognised that every musical instrument is as strictly subject to the laws of physical science as a chronometer or a locomotive.

In the year 1891 the late Mr. Hipkins delivered a course of Cantor lectures on "The Construction and Capabilities of Musical Instruments," and one of his three lectures was devoted to the "wind" section. The treatment adopted by Mr. Hipkins leaned rather to the musical use and position in the orchestra of the various instruments, than to the scientific or mechanical principles underlying their design, and as it is this latter side of the subject to which your attention will on this occasion be chiefly invited, any repetition of matter that was then so ably put before this Society, will I trust be borne with, as being led up to from a different point.

The three great groups under which all instruments are classed are the String, the Wind, and the Percussion, and it is the second of these which forms our subject. The Wind, however, for our purpose will be held to exclude all instruments such as the organ and the harmonium, which are played with a keyboard, and this limitation is customary. We have, therefore, to consider all such instruments as are blown directly from the player's lips, either with or without a vibrating tongue or reed. These, in combination, constitute the "wind band" in the orchestra, and practically the whole strength of the military band. They are commonly classed in two divisions as the "brass-wind" and the "wood-wind." terms which are recommended by custom rather than by accuracy: the further division of the "wood-wind" into reed instruments and flutes, introduces a better basis for classification, as these definitions neglect the material of which an instrument is made, and are based upon the means employed for tone-production. If to these two, "reeds" and "flutes," we add "cup-blown" or "lip-reed" in substitution for "brass," we have three definitions which are both accurate and practically convenient, and each one of these three groups will be the subject of the three subsequent lectures.

A complete survey of the history of wind instrument development lies outside the scope of these lectures, for our purpose is rather to deal with such instruments as they are, than as they have been, yet it may be of interest to pass in review the more important stages of progress.

The Table of classification here given shows the different families of wind instruments, with examples of each grouped under the three classes.

CLASSIFICATION OF WIND INSTRUMENTS.

Class.	Family.	Examples.
Brass or Lip-Reed.	Tubes of Fixed Length.	Trumpet, Bugle, French Horn.
	Length varied by Slide.	Trombone, Slide Trumpet.
	Length varied by Finger-holes or Keys.	Key-Bugle, Serpent, Ophicleide.
	Length varied by Valves.	Cornet, French Horn, Saxhorns of all kinds, Euphonium, Bombardon or Tuba.
Reed.	Enclosed Reeds.	Bag-pipe, Cromorne.
	Open or Mouth-Reeds (double).	Oboe, Bassoon, Cor Anglais.
	Open or Mouth-Reeds (single).	Clarinet, Saxophone.
Flute or Air-Reed.	Flûte-à-Bec.	Recorder, Flageolet.
	Flûte-à-Traversière.	Pandean Pipes, Cone Flute, Cylinder Flute.

As rudimentary types of these three classes I have here an Indian conch shell, kindly lent by Mr. Algernon Rose, a bag-pipe drone reed, and another short piece of reed stopped at one end. These may be compared respectively with a compensating four-valved euphonium or bass saxhorn, a modern clarinet, and a flute on Boehm's system.

There is good reason for the opinion that wind instruments, which in their present forms are of much more recent date than the string, are, in their primitive forms, older. The rudest string instrument would require for its construction more manual skill and mechanical aptitude than would be required to convert a conch shell or a hollow bone or tusk into an instrument which, although not musical in our sense of the word, would be useful for signalling either in war or in the chase. Particular illustrations of old instruments coming within historical times will be instanced as each group comes in review.

In the examination of wind instruments, one consideration comes very prominently before

us, and that is, the means they afford of obtaining some insight into the action of the human vocal organs. It is manifest that the voice proceeds from a wind instrument, highly complex, it is true, but approached more nearly by our comparatively simple wind instruments than by any other others, whether string or percussion. If I am right in this view, as I believe I am, our subject should be interesting not only to the specialist in wind instruments, but to the student of that most marvellous and perfect of all instruments, the human voice.

You may have noticed on the syllabus the statement that "every wind instrument is a vibrating column of air," but this definition requires some amplification. Expanding the definition, we may state that every wind instrument is a column of air of fixed or variable length and of definite proportions, capable of being put into longitudinal vibration of certain definite periods. To isolate such a column of air from the general mass it is necessary to avail ourselves of a tube of some rigid material, such as brass, silver, or wood, and it is this tube which, in common language, is called the instrument. The material of the tube, however, has but very small influence on either pitch or quality; the all-important factors are the exact form of the contained or isolated mass of air, and the means of exciting vibration. Here are three straight horns: two of them are of the bugle type, one being made of copper and the other of brown paper. You will notice that there is very little if any difference between them as regards their power and quality. The third horn is smaller in its general calibre, and for a considerable portion of its length is cylindrical instead of tapering. It is, in fact, a high-pitched trumpet, and you will notice the marked difference in tone-quality between it and the other two horns. Again, as an illustration of the effect of the means of exciting vibration, I will sound a few notes on the saxophone, a reed instrument; first by means of its proper reed and mouthpiece, and then by means of a trumpet mouthpiece, the general proportions of the instrument necessarily remaining exactly the same under each trial.

To put before you briefly the chief points influencing the results obtained in insrument making, I must ask you to follow me in considering the main facts in acoustics in so far as they concern our subject.

Acoustics may be defined as that branch of physical science which treats of vibratory motion as perceived by the sense of hearing. That a body giving forth sound is in a state of motion can in many cases be recognised by the senses of sight and touch, as when we see that a large string of a double bass is oscillating, or as when we touch a sounding-bell or drum-head. And we notice that anything which checks such motion, also checks sound: for instance, when we touch a wine-glass or tumbler at table which has been accidentally knocked; touching it with the finger, we stop its vibratory motion, and in so doing we stop the sound. That the air which is the medium of conveying sound from the vibrating body to the ear, is itself in vibration, is not generally self-evident, but when large and powerful pipes are sounded on the organ, we are sensible of the air in the neighbourhood of the instrument being in a state of tremor.

Before considering that variety of wave-motion evidenced by sound, the character of the motion of any particular particle under vibration must be understood, and this may be described as its recurrent motion about a defined position of rest. The most convenient illustration of this is the swinging of a common pendulum; for our purpose, let the amount of its swing be so small, that the curve of the path of its bob is not noticeable, and neglecting the wire or rod, we would have the bob travelling forwards and backwards over a short and apparently straight line. Let its position of rest be O and its total course of swing be from A to B:

O

A ——— A′ ——— ——— B′ ——— B

its motion from A to B, and back again to A, or from O to B, from B to A, and from A to O, constitutes a complete vibration, and the time occupied in the vibration is called the periodic time, or more briefly the period. The extent of the course from the position of rest O to the extreme position A or B is called the amplitude. The period is independent of the amplitude, for although the course of the bob should be only from A′ to B′ its time would be the same as if swinging from A to B.

This statement, that the period is independent of the amplitude, is subject to modification when the excursion from the position of equilibrium is very great, but it is true of such vibrations as we are concerned with in music, and anything like a *crescendo* or variation from *piano* to *forte*, would be impossible if this were not the case. Pitch is determined by the period or frequency of the vibrations, and

loudness by their amplitude, and if these two conditions were not independent of each other, music as we understand it would be almost impossible, for no variation in the intensity of a note could be produced, without an alteration of pitch.

Pitch and intensity in themselves, however, are not the only properties of musical sounds by which we distinguish one from the other. We easily recognise that sounds of the same pitch and intensity proceeding from different instruments vary greatly, and this variation we define as quality. This characteristic, quality, is due to departures from the simple condition of vibration illustrated by the swing of the pendulum. Such a vibration as that of the pendulum is known as simple harmonic, and is obtained from a large tuning-fork vibrating gently; it produces on the ear the effect of the vowel "oo" as in the word "food."

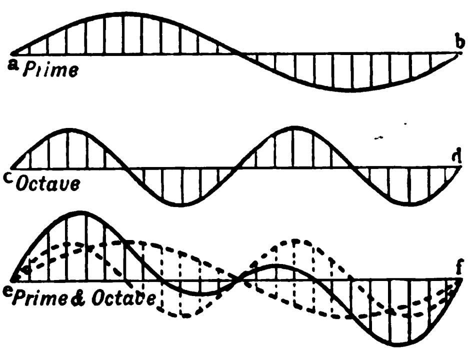
An illustration will assist us in understanding how two vibrations which are alike in period and in amplitude can differ in any way. Let a foot-race take place over a course say from starting-point A, to post B, and back again. It is evident that different runners may perform the race in the same time, and yet not keep together throughout the course. For one may keep an even pace throughout, another may improve a generally slow pace by occasional spurts, while a third may begin at a great speed and occasionally slacken, and a fourth may gradually improve his pace from beginning to end. Particles of air may behave just in the same manner in their courses or oscillations, and each such variety in the way vibrations otherwise similar are executed, affects the ear with the sensation of difference of tone-quality.

The diagram shows two simple wave-forms, *a—b* and *c—d*, corresponding to a prime and its octave, and one wave-form *e—f*, compounded of these two.

The amplitudes of the waves *a—b* and *c—d* are similar, and each of these curves is shown by dotted lines for comparison with the compound curve. It will be seen that the displacement from the straight line of any point in this compound curve (represented by the full line) is equal to the sum or difference of the displacements of similar points in the curves *a—b* and *c—d*.

We shall presently consider the transmission of sound from a vibrating body to the ear by aerial waves, but in the mean-time may note that the varieties of pitch and quality which produce such deep impressions upon our faculties, "from grave to gay, from lively to reverse," depend, as a matter of measurement, upon exceedingly small divisions, both of time and of space. Musical sounds vary in period from about $\frac{1}{40}$ to $\frac{1}{5000}$ part of a second: as the higher limit of pitch is approached, the distinctions of quality get weaker, but if we take a period of about $\frac{1}{500}$ of a second, or about the middle note of a soprano voice, we must acknowledge that at that pitch we can recognise innumerable differences of quality, and the only rational explanation we can give of these differences is that they depend upon the various ways in which a particle of air may travel over a minute space in a minute interval of time, which in the particular case named is $\frac{1}{500}$ part of a second.

Thus far, we have mentally isolated an individual particle, but in nature a single particle cannot have vibratory motion imparted to it



without influencing other particles in its neighbourhood, for all substances, whether solids, liquids, or gases, have their particles associated or linked together in equilibrium by certain forces, such as attraction and repulsion, and elasticity. The result of inter-action among particles thus associated is wave-motion, and it is by wave-motion in the air that the vibration excited in a solid or gaseous body reaches our ears.

We may consider what takes place when any given particle is displaced from its position of rest, say from left to right. The particle next to the displaced one has the equilibrium of elasticity on each side of it disturbed, and moves on to re-establish equilibrium, and so with each particle in succession.

By the time the particle first displaced has completed a vibration a series of particles has been put into motion, and another particle at a certain distance is ready to commence a

similar course. A wave-length is the distance between a particle in a given position, with motion in a given direction, and the next particle in a similar position and with motion in the same direction. Thus while an individual particle performs one complete vibration, the wave, consisting of a condensation and a rarefaction, advances by one wave-length. The impulse is passed on from particle to particle and the result is wave-motion.

Wave-motion may consist either of a rising and falling across the direction in which the waves travel, of which variety sea-waves, or the waves caused by wind under a carpet are examples; or of a swinging forwards and backwards in the direction of the wave's progress: this latter variety of wave-motion may be seen at times when a field full of corn is agitated by the wind, the swaying of the corn under the wind gives a better idea of vibrations in air than sea-waves give. A complete wave contains both a condensation or compression and a rarefaction or expansion; the air or other substance in the condensed portion of the wave occupies less than its natural space, and that in the rarefied portion occupies more.

The velocity of sound is the rate at which sound waves travel, and is independent of the period, the amplitude, and the form of the wave. It is dependent, however, upon the elasticity and density of the medium through which the wave passes, and in air, the only medium which we have to consider in these lectures, it is about 1,120 feet per second at 60° Fahrenheit, varying with the temperature in a manner which will be referred to later. In cylindrical tubes of the sizes used in wind instruments the velocity is very slightly less than this, but the difference is too little to require consideration in ordinary practical work. In this connection it may be interesting to note that wind instruments, which in their dimensions are determined by this velocity of sound, and which range in size from the piccolo flute to the contra-bass saxhorn, fall within limits of size and weight which can be conveniently handled, and such limits would be impracticable if the medium were hydrogen gas instead of air. For as the velocity of sound in hydrogen is nearly four times as great as in air, the little piccolo would have to be about a yard long, and the contra-bass would be about the length of a cricket-pitch.

The following Table shows the relationship between velocity, wave length, and frequency, or number of vibrations. The standard of pitch (c'' = 512 vibs.) generally used in scientific work has been chosen, but the method of constructing the Table is independent of the particular pitch.

Velocity of sound { 1,120 feet = / 13,440 inches. } per second at 60° Fahrenheit

Note.	No. of Vibrations.		Wave Length.	
	Absolute	Relative	Relative	Absolute
				Inches.
c'''	1,024	8	$\frac{1}{8}$	13·125
b♭''	896	7	$\frac{1}{7}$	15
g''	768	6	$\frac{1}{6}$	17·5
e''	640	5	$\frac{1}{5}$	21
c''	512	4	$\frac{1}{4}$	26·25
g'	384	3	$\frac{1}{3}$	35
c'	256	2	$\frac{1}{2}$	52·5
c	128	1	1	105

Now although the number of vibrations giving various notes, and the corresponding absolute wave lengths, are of great importance to those who have to design and make instruments, they are points which have no supreme importance in our general scheme of examination. The really important columns on the diagram are those with the heading "Relative," in which is to be seen the relationship between frequency and wave length for different notes in harmonic relationship, apart from any particular pitch, high or low.

It has been abundantly proved that the more perfect and satisfactory musical intervals depend upon simple ratios between the vibrational times or frequences of the notes producing the interval. The intervals given in the Table are those of the harmonic series, or the series of open notes on a brass instrument (*i.e.*, notes that can be produced on such an instrument without any contrivance for altering its length), such as a bugle. Comparing the numbers in the third column with the corresponding notes in the first, we notice the extreme numerical simplicity ruling the most important musical intervals. For instance, in the common chord *c—e—g*, for every four vibrations of *c* there are five of *e* and six of *g*. [These chords were given on tuning forks.] Sonorous vibrations are mainly of two classes, transverse and longitudinal.

When a stretched string, such as a violin string, is thrown into vibration, it is usually by a displacement which causes oscillation *across* the direction of its length; this is an instance of transverse vibration. But by lightly drawing a resined rag *along* such a string or along a wooden rod, such as is fixed in this vice, it can be thrown into longitudinal vibration.

Experiment.—Rod in transverse and in longitudinal vibration.

Experiment.—Weighted steel coiled spring illustrating transverse and longitudinal vibrations.

We can throw a gaseous rod or column of air into longitudinal vibration, as illustrated by the wooden rod and the spring, and confining our attention in the first place to cylindrical tubes, we must endeavour to arrive at a clear conception of the distinction betwen progressive waves and stationary waves.

The wave, which on this revolving disc appears to issue from the centre and travel to the circumference, represents a sound-wave, as it travels through free or unconfined air, or through a tube of indefinite length: every particle of air through which it travels takes up in turn exactly the same motion, making allowance only for the gradual enfeeblement of the wave. By such progressive waves our ears receive the sensation of sound from musical instruments, but the waves set up in the instruments themselves are of the class known as stationary waves. This variety of wave can be illustrated by means of another disc.

When a pulse of condensation as from a tuning-fork, passes along a tube with a closed end, it is there reflected, and when the period of such a double passage agrees with the half-period of the fork, a powerful resonance is the result. During the other half-period of the fork, a pulse of rarefaction is similarly travelling over the length of the tube twice. [Experiments were here shown to illustrate these points.]

In a tube closed at one end, a pulse has to travel over the length of the tube four times to complete its cycle, that is, to and fro as a pulse of condensation, and to and fro as a pulse of rarefaction. The lowest note to which such a tube can give a perfect resonance has therefore a wave-length four times the length of the tube.

A tube open at both ends, behaves, when sounding its lowest note, as if it were two closed tubes such as we have been experimenting with, placed with their closed ends together.

As the waves from each end travel in opposite directions, they meet in the centre, and are reflected, just as they would be from a solid surface. In neither case can the oscillation of the air-particles pass this plane of reflection, and the consequence is that at this reflecting surface the air is at rest, but its density varies between a state of maximum compression and maximum rarefaction.

This action is more easily traced when a tube is taken of sufficient length to comprise two or more nodes; the nodes, or surfaces, where the air is at rest, then alternate is position with points or surfaces called anti-nodes, or loops, where it is in a state of maximum motion.

The condition of any node varies with the motion of the air on each side of it, which is in contrary directions, and at the loops, midway between the nodes, the density of the air remains unchanged. The distance between two adjacent nodes or loops is a ventral segment, and the distance between two nodes which are in the same condition is the wave length, which, for any given note is equal to the velocity of sound divided by the number of vibrations producing that note.

It is because a node is a point of no motion, but of reflection, that a tube may be closed at such a point without influencing its note, but at no other point, and that only those notes whose waves have a node in the position of the closed end can be sounded on a closed tube.

A moment's consideration will make it clear that when air in a tube, with one or both ends open, vibrates, there is an alternate influx and efflux of air, for the air required to increase the density at the node can only be supplied from the outer air, and conversely, the rarefaction can take place only through air passing from the tube into the outer air.

In these experiments we have excited vibration in the tubes or air-columns by forks, but in practical instruments, which are rarely cylindrical tubes, other means are employed, and these means form the basis of the classification adopted. In the next lecture we will consider the results obtained by the various modifications of the cylindrical form of tube, and by the use of the lips in place of forks to excite vibration, tracing the development from the simple shell or horn to the modern brass instrument.

ST. LOUIS EXHIBITION.

The following retrospect of the exhibition just closed is from the special correspondent of *The Times*:—

It has long been evident that, looked at from a financial point of view, as well as from that of both attendance and influence, this exhibition, perhaps the last of its kind—was certain to be a comparative failure. It is not difficult to account for this. In the first place, the people of St. Louis are not active, enterprising, money-spending people like those of Chicago. In like manner, the surrounding population does not compare in these respects with that of the city by the Lake. As an effect of this the purely local interest has been slight from the opening days. It soon became apparent that there was to be a reasonable attendance from States comparatively distant, but a light one from St. Louis itself. It must not be overlooked that this verdict is modified by the use of the word comparative, because even in the remainder of the country the interest has not been large. From the beginning the exhibition has attracted only the slightest attention in the Press, and it would probably be safe to say that three times as much matter of a serious character has been published about the exhibition in the Press of London as in New York and Philadelphia, the two combined about equalling the population of London. In fact, it has been surprising to find how little attention has been devoted to what, in all intents and purposes, was a Government project. This being the case, there has been little interest in the awards. This is, perhaps, accounted for by the fact that, so far as domestic industries are concerned, a large number of the houses connected with them are so new that they know nothing of the old struggle for what were called industrial honours. Perhaps the tendency to combination which removes competition also removes the incentive for seeking the kind of recognition hitherto deemed of importance and value.

It was estimated by the enthusiastic organisers that the exhibition would attract not fewer than 30 million visitors, and in many quarters the predictions placed it at a much larger figure. The total attendance at Chicago amounted to about 28 millions, of which the usual proportion of three-fourths was paid in admissions, the remainder being what is known in the theatrical profession as paper. So far as can now be determined, the attendance at St. Louis has amounted to a scant 14 millions, of which not more than 10 millions will be paid in money at the gates—the proportions of free admissions being somewhat larger, according to present indications, than at either Philadelphia or Chicago.

But perhaps the strongest influence that has been at work is the conscious recognition of the fact that great exhibitions have been overdone, and that they no longer have a direct, or even an indirect, value compared with those held in earlier days. Then, too, there is a very strong feeling in the minds of many people that they are used to push the fortunes of ambitious men, otherwise uninteresting or unsuccessful, and that, too, at the expense of the general Government, the State, or a city, or all combined. This is true, in spite of the fact that some of the men connected with the organisation and management at St. Louis have done a great deal of work under many difficulties, and have had only the slightest real recognition at home, and, in many cases, have been compelled to meet a great deal of criticism that was wholly unjust. Another element that has entered into account is the fact that the occasion itself was not so uncommon or so important as to attract general attention. That the Louisiana purchase was a very important event in the history of the United States is not open to question, but as it merely marked the continuation of a policy which began with the earliest days of American history, and as it was only the largest of many like acquisitions, the imagination of the country has not been excited by it as it was by the centennial of the Declaration of Independence and by the fourth centennial of the discovery of America.

When all these forces are taken into account, there is no occasion for surprise if the end of the present exhibition is welcomed by more people than its opening, and by none more cordially than by those who had been at the head of the movement. It would be absolutely impossible for any one who had not known the inside to appreciate the pettiness, the jealousies, or the open opposition that its leading men, especially its president, have had to meet and overcome. In many respects, it has been a conspicuous failure, largely because a great deal more was undertaken than ought to have been and because the schemes grew upon its organisers as new demands were made for money and upon their own capacity for management.

It is probable that this is the last attempt that will be made in this country to celebrate any great act by a universal exhibition. I have had occasion, from time to time, to outline the difficulties and to set forth the great amount of money necessary for carrying out such a scheme. It is not likely that any contributors will ever come forward again to furnish a like sum of money for this kind of display.

COLONIAL PRODUCE.

The exhibition of Colonial produce at the Royal Horticultural Hall should be of use to the colonies exhibiting. Everything that tends to make the British consumer better acquainted with Colonial products is welcome. The idea of the Old Home Society holding exhibitions of Colonial produce has only been rendered possible for the first time this year by the completion of the society's new Centennial Hall, in Vincent-square, Westminster. In the present exhibition, the Dominion, and some of the principal West India islands, are the chief exhibitors. The Dominion exhibits were mostly apples, and some of them, those

especially from British Columbia, are very fine, and in excellent condition, notwithstanding a journey of 6,000 miles, half of it by land. In flavour, size, appearance, and market qualities they leave nothing to be desired. The exhibits from the West Indies were much more varied. There has been a great development in the fruit trade between these islands and the United Kingdom since the Government subsidised the Elder Dempster line running to Jamaica. Under its new management, and influenced no doubt by the Jamaica competition, the Royal Mail Steamship Company is offering facilities to fruit shippers, and the shipments of bananas from Barbados and Trinidad are already considerable. But it is slow work, even with bananas, largely owing to the fault of the growers. They are unbusinesslike, and careless of the market. Large as are the shipment of bananas from Jamaica, they would be much larger if the bananas shipped were of the right kind. But the Jamaica planters have been accustomed to grow a particular banana for the American market, a long coarse banana known as the *Gros Michel*, and it is this fruit they send to England although it does not suit the English taste, or fetch more than half the price of the dwarf banana (*Musa Cavendishii*) that comes from Barbados and Dominica. Then again the Barbados planter, though keen enough in some ways, is slipshod. He will write over for a quotation, and if it does not suit him—and he is not easily satisfied—nothing more will be heard of him. There are not many plantains at the exhibition, which seems a pity. It would be a real boon to the poor if plantains were as plentiful and cheap on this side as bananas. They are an excellent and sustaining food, and when well-cooked, very palatable. It was interesting to note among the Barbados exhibits, some very fine cotton of the Sea Island variety. There are now 1,600 acres of this cotton in cultivation in the island, and the growth is rapidly extending. A very fine spadix of palm nuts is exhibited by Trinidad and has been secured by Sir W. Thistleton-Dyer for the museum at Kew. Trinidad is beginning to develop the palm oil industry and is already exporting. Dominica, which a few years ago was perhaps the most backward of the larger West India islands, is now making rapid headway. Cacao has become an important article of export, and large plantations have been successfully established in the highlands of the interior. Rubber trees grow luxuriantly, and there is a considerable export trade in lime juice, and limes in all forms. The island owes much to its present energetic administrator, Mr. Hesketh-Bell, who is inducing many young farmers to try their fortune in Dominica. It offers great possibilities to young men conversant with farm work, possessed of a modest capital, not afraid to work, and of cleanly life. There was a fine show of shaddocks at one of the stalls, but there is never likely to be much of a demand for them in this country. They are too large and coarse, but eaten West Indian fashion, with the core cut out and port wine poured in and allowed to soak for a day, they are inviting. How is it, by the way, that no enterprising firm sells shaddock bitters? Orange bitters have a large sale, and those who have tried both think shaddock the better.

At present there are considerable difficulties in the way of West Indian fruits, other than bananas, being sold largely in this country. The main difficulty is in the unwillingness of the retailer to handle them. Until the public are better acquainted with their merits, he runs a great risk of the fruit rotting before it is sold, and the only way to make the public more appreciative would seem to be the establishment here and there, in favourable positions, of shops making a specialty of these fruits and inducing the public to test them. These shops would have to be subsidised for a time, and it ought not to be very difficult to induce exporters and carriers, that is to say planters and steamship companies, to provide a fund for this purpose. There is a difficulty in the way of the Royal Mail Steamship Company being a contributor to such a fund since under its charter it is not allowed to engage in any other business than that of carriers, but there are ways by which this difficulty could be got over. It is a curious fact that, whilst the charter of the Royal Mail Steamship Company is so rigid in vetoing any business but the one for which the charter was granted that the company may not erect or work a West Indian hotel, the Government contract with Sir Alfred Jones's line not only permits but encourages the company to go into hotel management. But then the charter was granted in 1838, and the contract was signed only a few years ago.

CORRESPONDENCE.

THE PATENT LAWS.

I much regret that illness prevented me from being present at the reading of my paper and the subsequent discussion.

I was glad to note that the speakers were all, more or less, in agreement with me on the main arguments of my paper, and I have therefore much to say in reply to the several points raised. I may state, that in the original draft of my paper, I had referred to all these points, and a great many more, but the paper became of an impossible length, and I had therefore reluctantly to cut out more than half the subject matter and to confine myself to the main arguments which I desired to bring forward, *i.e.*, the fallacy of the German and United States' system of examination, the advantages of the system about to be introduced here, and the necessity of making that system as perfect as possible.

With regard to the Chairman's remarks, I have to say that I had pointed out in my original draft that when I spoke of meritorious inventors deserving

recognition by the State, I referred to those who, besides making their invention, also devoted their energies and capital to carrying the same into practice, as I quite recognise that there is as much merit in this as in making the invention, and I have, in fact, said as much in my paper.

The inventor who merely puts more or less crude ideas into a patent specification, and leaves entirely to others the task of putting them into practical shape, is, to my mind, hardly entitled to patent protection, because, as I have pointed out in my paper of 1865, patent protection was not instituted so much as a reward for the ingenuity displayed in making an invention, but rather to act as an inducement to inventors to devote their energies to and their money in carrying the same into practice.

In this connection I may say that, in my opinion, the Swiss law, which requires proof of the invention being carried out before granting the full patent, is sound enough in theory, but, unfortunately, as is usually the case, the carrying out of this law has been surrounded with so much red tape as to be in very many cases objectionable in its operation. With regard to Messrs. Justice and Hardingham's remarks, I may say that in my original draft I had fully pointed out the imperfect nature of the examination about to be carried out by the Patent Office, but, at the same time I showed that at anyrate the Patent Office was going to do for a nominal charge what at the present time it cost many inventors a very considerable sum to have properly performed, and that as practically most inventions of any importance patented in Germany and the United States were also patented in England, one search would cover considerably more than merely the inventions made in this country.

As this question as to what constitutes a prior publication of an invention is a purely arbitrary one, I see no reason why the Government, while deciding that inventions described in patents more than fifty years old, and in abandoned provisional specifications, should not be considered prior publications, might not have gone a step further, and enacted that only inventions described in English patent specifications should be considered as anticipating publications.

As practically no invention is made in this country without being patented, such a law would entail no hardships on British inventors.

With reference to Sir Lloyd Wise's letter, if he reads my paper he will see that I quite agree with him as to his objection to the rule enabling the Comptroller-General to cite anticipating patents in the specifications, but I do not agree with his apparent interpretation of the rules to the effect that the objectionable notice is to be inserted by the Comptroller whether the applicant decides to refer to the anticipating patent in his specification, or not to do so.

Section 6 of the Act of 1902, states that the Comptroller "shall after hearing the applicant, *and unless the objection be removed by the specification*, to the satisfaction of the Comptroller, determine whether a reference to any, and if so, what prior specifications ought to be made in the specification.

Surely the "objection" would be "removed" by the applicant "amending his specification" in referring to the prior patent in question, and pointing out where his invention differed from the same; and in this respect the applicant would have the safeguard of an appeal to the law officer, as provided in Section 7.

The Comptroller has a large and difficult task before him, and I do not think he should render it more difficult by a premature wholesale condemnation of the new rules, but should rather wait to see how they are carried out before complaining.

The Patent Office has shown good sense and consideration heretofore in its dealings with patentees, and I think we can fairly trust the Comptroller to carry out the new law with due consideration for the interests of inventors. Mr. Guttman spoke somewhat disparagingly at the meeting as to the qualifications of the examiners of our Patent Office as compared with those of the German Patent Office, but I must say that, as far as my experience goes, the greater efficiency lies quite the other way. I have frequently had to contrast the unreasonable and frequently incorrect arguments and requirements of the German and United States examiners with the generally reasonable and pertinent objections raised by the examiners of our Patent Office, and, however superior the previous training of the German officials may have been, I do not find that they are equal to those of our Patent Office in the matter of common sense views.

CHARLES D. ABEL.

22, Charlton-road, Blackheath, S.E.
19th December, 1904.

THE BRITISH CANALS PROBLEM.

The contentions put forward in Mr. Lee's letter on this subject in last week's *Journal*, do not by any means dispose of the objections against the scheme of local control. Mr. Lee argues that the railway companies could crush private enterprise by reducing railway rates, and that from the same cause the capital expended on developing a waterway might be deprived of all return. One is entitled to ask in what respect the local authorities would fare better. I contend that as far as the financial results are concerned, no distinction can be recognised between one and the other, and as long as the railway companies are free to fix what rates they choose (and I presume that no legislative attempt will ever be made to interfere with that freedom) the local authorities would run precisely the same risks as the private owner. In other words, Mr. Lee's contentions on this point exactly confirm and strengthen my arguments against the expenditure of enormous sums of public money in a direction where the probability of any return is so largely a matter of conjecture. It is perfectly obvious that the

canals will always have to reckon with the competition of the railway, but it is certainly not so obvious how that competition can be lessened by substituting municipal in place of private ownership. The local authorities themselves have, I believe, taken this view of the question, and shown unmistakable objections to rush in where private enterprise fears to tread. I think, in fact, I am safe in asserting that neither Parliament nor the municipal authorities will have anything to do with a scheme of canal development which carries with it a certainty of vast unprofitable expenditure. Mr. Lee thinks it unreasonable to point to an increase of debts without considering any increase in the value of the assets, and cites the growth of railway debt between the years 1872 and 1892, but I fail to see how this bears upon the question. In the first place the railway constitutes our principal means of inland transport and locomotion, and in increasing their assets the railway companies have simply kept pace with the growth of population and public requirements. With this increase of debt there has been a commensurate increase in traffic receipts. Had there been no such result, then assuredly the railway companies would be pursuing a policy which would speedily land them and the nation in bankruptcy. The canals are in an utterly different position to the railways. They constitute a subsidiary means of transport, and one not likely to increase in favour with the industrial community. The railway and the road will be keener competitors in the future than ever before, and to what extent, traffic will be diverted from them to the canals, or exisfing traffic on the latter increased, no one has been bold enough to estimate. I think, therefore, that it is perfectly reasonable to emphasise the point that heavy expenditure on canal development is likely to be unproductive. I scarcely think the ratepayer would be satisfied with the knowledge that though his rates might be increased he could console himself with an increase in the value of unproductive municipal assets. I am glad that some local uthorities, at least, have shown no favour to such slipshod finance.

There is another aspect of the canal problem to which I may briefly refer. Mainly through the suicidal policy of the canal companies in the forties of maintaining high rates, the railway companies were able to acquire, between the years 1845 and 1848, 1,000 miles of canals, so adroitly chosen that at the present time they constitute the key of the situation. Assuming that the local authorities acquired any particular waterway, it would probably be necessary to buy from the railway companies other canals controlling through-navigation, in order to prevent the imposition of restrictive or prohibitive rates. Here we have an appalling prospect of unlimited expenditure, and yet, according to the scheme of local control, it would be a matter of necessity for the local authorities to embark on that expenditure in order to make the fullest use of the canals they might acquire. I think I am justified in saying that this would be a disastrous course to adopt. Fortunately, it is unnecessary, and, judging from the attitude of certain municipalities, one which it is extremely improbable will be followed. In the interests of canal development it is a matter of regret that the promoters of the scheme do not recognise its impracticability, and address their energies to something which has a chance of being accomplished. The first object to be aimed at is the abolition of high tolls on the railway-owned canals and the removal of all obstacles to their legitimate use. When this primary evil has been removed, the most formidable impediment to canal development will disappear. Others will remain, but none that cannot be remedied by private enterprise. One thing is certain. Our waterways are never likely to regain a tithe of the importance which belonged to them 70 years ago, when dividends of from 30 to 80 per cent. were not uncommon, but their utility can be increased if those who are interested in the improvement of their condition will recognise the limitations of canal transport, and promote no schemes which entail either nationalisation or municipalisation.

W. D. McConnell.

64, Burma-road, Clissold-park, N.
Dec. 19th, 1904.

GENERAL NOTES.

Martinique.—Figures supplied by Mr. Consul Meagher in his report on the trade of Martinique (just issued) afford striking proof of how British shipping finds its way to foreign ports doing only a very small trade with the United Kingdom. Thus whilst the total value of imports into Martinique in 1903 amounted to £815,582, of which no less then £743,867 came from France, French colonies, and the United States, and the exports amounted to £604,162, of which £563,329 went to the same countries, the tonnage of British shipping entered in the port of Martinique in the same year was greater than that of any other country not excepting France, and the same remark applies to vessels cleared. Only six American vessels, aggregating 4,210 tons, were entered, although America's imports (£260,706) amounted in value to nearly one-third of the whole.

MEETINGS FOR THE ENSUING WEEK.

Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Mr. Henry Cunynghame, C.B., "Ancient and Modern Methods of Measuring Time."

Tuesday, Dec. 27. Ancient Sundials and Clocks.

Thursday, Dec. 29. The Discoveries of Galileo.

Saturday, Dec. 31. The Pendulum and Balance Wheel.

Journal of the Society of Arts.

No. 2,719. VOL. LIII.

FRIDAY, DECEMBER 30, 1904.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 4, 5 p.m. (Juvenile Lectures.) CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Lecture I.)

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 4th and 11th, at 5 o'clock, by Mr. CARMICHAEL THOMAS, Treasurer of the Society, on "The Production of an Illustrated Newspaper."

Each member is entitled to a ticket admitting two children and an adult.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received.

Nearly all the tickets have now been issued, and members are therefore requested to apply for them at once.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MUSICAL WIND INSTRUMENTS.

By D. J. BLAIKLEY.

Lecture II.—Delivered December 5th, 1904.

Before proceeding to the specific subject for this evening's lecture, *i.e.*, Brass Instruments, I must ask you to be so good as to follow me in a brief recapitulation of some of the points introduced on Monday last. We then considered the vibration of any particle as its oscillation about a position of rest, and wave motion as being the transference of such vibration from particle to particle. As it is of importance, in view of other illustrations coming before us, to have a clear idea of the distinction between the vibration of a particle and the advance of a wave, I will put in motion again the disc illustrating the advance of a wave of sound, and also the disc illustrating a stationary wave.

[Experiments with disc advancing wave and stationary wave.]

It was further stated that an open tube had for its proper tones, or tones to which it could naturally respond when excited by tuning-forks or other means, the notes of the harmonic scale, or those whose ratios of vibrations are represented by the simple arithmetical progression 1, 2, 3, 4 ...... 8, &c., &c. This can be illustrated by a tube I have here.

[Experiment with open tube excited by forks sounding c, c′, g′, c″.]

It was also stated that a cylindrical tube stopped at one end could give only those notes of the harmonic series that are represented by the odd numbers, 1, 3, 5, 7, &c., or c, g′ e″, &c.

[Experiment with closed tube excited by forks.]

There is one other simple form which has its natural tones in the same order as the open cylindrical tube, or other tube of equal section throughout. This form is the cone.

[Experiment with paper cone and forks.]

Before passing on to the examination of the actual forms of brass instruments, this consideration will naturally present itself to your minds; can the action of the lips be held to be the same as regards pitch, as the excitation of the air in a tube by vibrating forks?

I have here a small hunting-horn, giving the note c 512 vibs. when blown by the lips in the usual way. If instead of blowing the instrument, we excite vibration by holding a vibrating tuning fork of this pitch over its mouth, we notice that there is little or no resonance so long as the tube is open, but directly it is closed by the rim of the mouth-piece touching the sur-

face of water in a glass, the note of the fork, which agrees with that of the tube when closed, is distinctly heard.

From this experiment, we must understand that a brass instrument is a tube closed at one end, as is indeed, pretty self-evident, but it is also manifest that it is not a cone complete to its apex. There are certain wind instruments, such as the oboe and the bassoon, in which this is practically the condition, but the closed end of a brass instrument must have sufficient width for the action of the lips.

By cutting off a portion of the cone, we can get room for the action of the lips; this cone can be divided at the position of one of the nodes of c″, its fourth proper tone. That note can therefore be sounded, but no other of the original harmonic series of the cone; the other notes possible are inharmonic, the c″ being the third of the series:—

1st. Divided cone gives c sharp, e flat, c″.

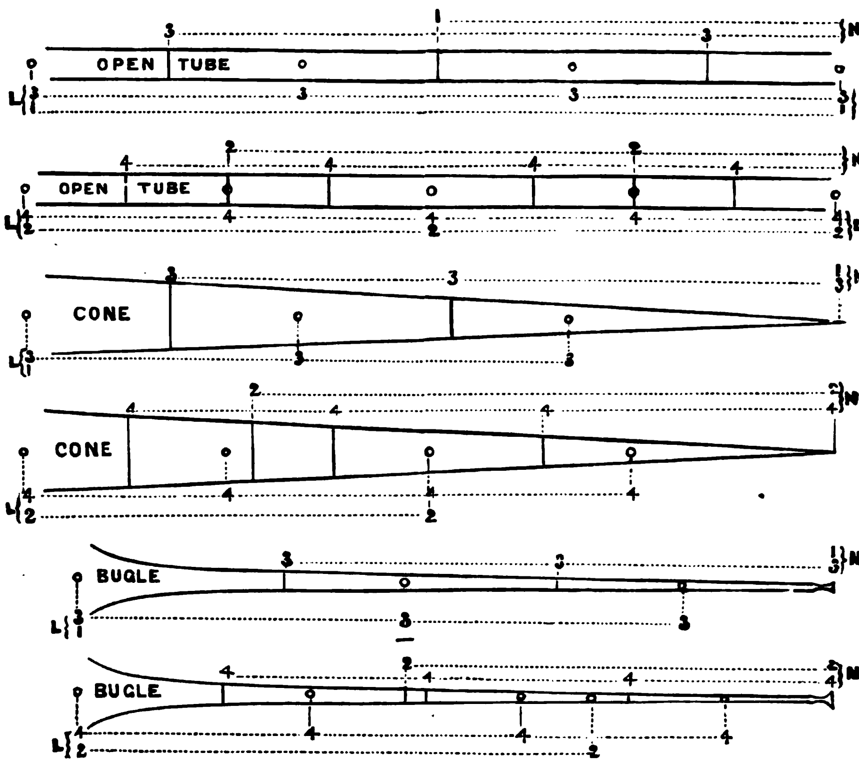
2nd. Another tube c′, c sharp$_1$″.

3rd. Another tube c′, e″.

[Experiments with truncated cones.]

From these experiments, it may be seen that by using portions of cones of different proportions with their small ends closed, it is possible to get different series of intervals, varying between those of an open and those of a closed tube; that is, the first interval varying between an octave and a twelfth.

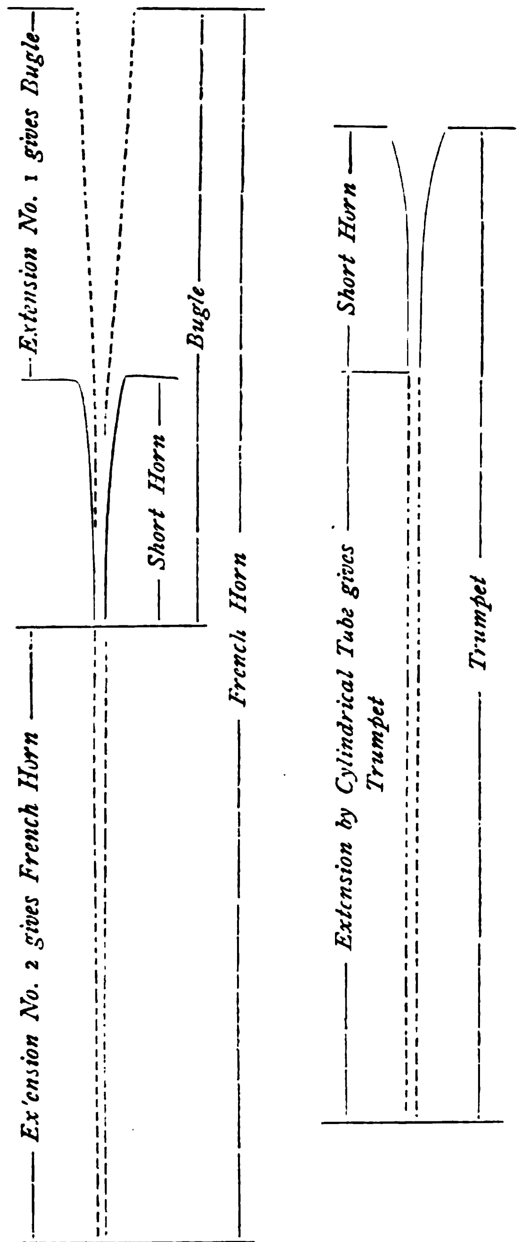
The second example given, c′, c″ sharp, does not appear to be far removed from the required condition: but as cylindrical tubing must necessarily be added to such a cone in practice, either by means of valves or slides, we may try the effect of such an addition. Flattening the cone a fourth from c′ to g by adding cylindrical tube, we obtain the notes g, e′, d″ in



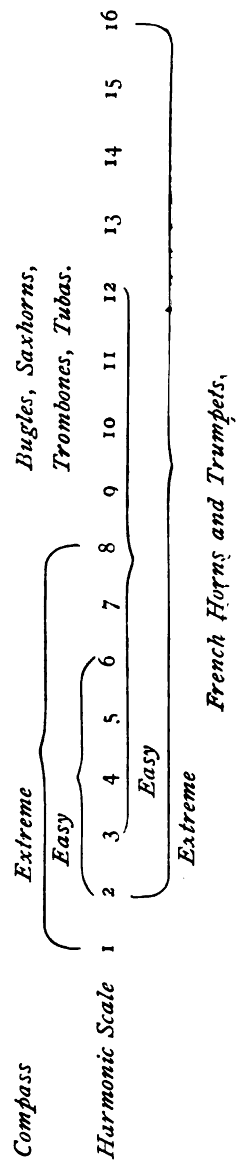
place of the g, g′, d″ required, or notes in the ratios 1, $1\frac{2}{3}$, 3, in place of 1, 2, 3, the second interval being actually greater than the first. Other modifications might be shown, but the result of them all is that the sudden change of form from a right cone to cylindrical tubing cannot give the desired result, which is a tube of such form, that though it is closed at one end, its proper tones shall be those of a cylindrical tube open at both ends.

Seeing that a bugle, or other such instrument, although it has a considerable diameter at the mouthpiece, may nevertheless be in tune, it appears that its various nodal surfaces cannot be in the same positions as those on

the cone. On the diagram is represented a bugle of the same pitch as the open tube and the cone, with the positions of the nodes and loops of the first four harmonic notes. Comparing the positions of the nodes and loops for any given note, say No. 4, it will be seen that on the bugle the length from mouthpiece to node is more nearly equal to that between similar nodes on cylindrical tubing than to that between similar nodes on the cone, but from node to mouth or bell-end is greater than on the cone, the bugle opening more rapidly. Thus, then, by altering the proportions of the different semi-ventral segments of which a brass instrument may be conceived to be built up, the positions of the nodes may be so arranged that there is a node for every note at the mouthpiece as required, and according to the degree of accuracy attained in this, will the instrument be more or less accurately in tune.



DEVELOPMENT OF WIND INSTRUMENTS FROM THE NATURAL HORN.



We have on the table a series of four bugles, one undivided, giving c as its prime, and three divided into segments for the c′, g′, and c″; and four cylindrical tubes similarly treated. These correspond with the bugle and open tube on the diagram.

From any segment we can obtain the note proper to that particular division.

[The notes proper to each segment, and to the various groupings of the segments were here given by blowing.]

As the nodes are planes of reflection, it is possible to put diaphragms in the nodal positions, corresponding to a particular note, without preventing the speech of that note, but a diaphragm thus placed will effectually block out vibrations of the periods necessary for other notes. [Experimentally shown.]

With these fundamental points before us, we are in a position to understand the scientific facts underlying the history and practice of wind-instrument manufacture.

The brass wind may very well be compared with an ox-horn as a standard of reference. Such a horn is here: with the exception of the cupped mouthpiece, it may be regarded as a natural object, and is therefore almost as simple an instrument as the large shell. By means of a slide on the screen, the relationship of modern instruments to it can be traced out.

The short natural horn being taken as the rudimentary type, its extension in length, without alteration of calibration, results in the bugle; further extension, with reducing diameter at the small end, gives the French horn. These two, the bugle and the French horn, may stand as representative of all conical instruments, as the modern saxhorns and tubas are, speaking broadly, enlarged bugles.

When cylindrical tubing, however, is added to the short horn, the type of instrument obtained is the trumpet, which, with some alteration of calibre and length, becomes the trombone.

Before describing in detail the means successively used for completing the chromatic scale from the notes of the harmonic series, some reference may be made to the chief causes influencing tone-quality. [Three brass instruments of different tone-quality, the euphonium, the trombone, and the French horn, were sounded.]

The different tone-qualities of these instruments depends chiefly upon the relative strength of the upper partials or harmonics in comparison with the prime, and this variation in strength is mainly due to three factors, viz.:—

1st. The general form of the instrument in its calibration.

2nd. The extent of the bell flange, and

3rd. The exact form of the mouthpiece.

1st. *General Form.*—An open, spreading bore favours the strength of the lower partials, and this results in a bold and broad tone of the bugle type. When the calibration is small compared with the length of the instrument, as on the French horn, the tone becomes more tender and refined, but lacks virility, and perhaps dignity.

Again, keeping the general diameter small, but making a large proportion of the tubing cylindrical, we obtain the trumpet with its brilliancy, and the trombone with its great range of expression from martial ardour to the most solemn dignity. These results depend in some degree upon the character of the reflection of the wave at the open end of the tube. For the reflection to approach completeness, the diameter must be small in comparison to the wave length.

2nd. *Extent of Bell Flange.*—When the bell-mouth is wide, either from the general calibre, as on the bombardon, or by an extension of the flange, as on the French horn, the diameter becomes considerable with respect to the wave-length of the upper partials, and these become very much damped.

[*Experiment.*—A bell with wide flange was substituted for the ordinary bell-mouth on the bugle, causing a marked modification of the tone-quality.]

3rd. *Form of Mouthpiece.*—The cups of the mouthpieces of brass instruments vary from an almost hemispherical form to that of a deep conical funnel. The shallow or hemispherical cup is used with trumpets and trombones, and tends to strengthen the upper partial tones. The funnel form belongs to the French horn, and the intermediate degrees of depth are used for the various kinds of bugles, cornets, saxhorns, and tubas.

It is evident that the notes proper to the lower part of the harmonic scale, from Nos. 1 to 8, do not suffice for the diatonic scale, and still less for the chromatic, but between the 8th and the 16th harmonics lie many notes required for the diatonic scale. If we lower the pitch of an instrument an octave by making it longer, the note originally the 4th becomes the 8th and the 8th becomes the 16th. By the mere lengthening of an instrument, therefore,

its musical usefulness, so to speak, is increased.

Side or Finger-holes.—One means of obtaining a scale on a lip-blown instrument, which has died out only in our own time, is the use of side or finger-holes. By boring a hole in the side of an instrument its length is virtually altered, and six such holes, controlled by six fingers, give, with the original full length of the instrument, the seven tones of the diatonic scale, capable of being repeated in the octave, by over-blowing. These instruments were known as "zincken" in German, or "cornetti" in Italian. The weak point in the larger of these instruments (the serpents) was their bad intonation, through the necessity or supposed necessity of considering the span of the fingers. With the general adoption of key-work this necessity disappeared, and the result was that the bass members of the family have only become obsolete in our own day. The serpent, which was a conical tube sounding the 8 foot c and its harmonics, was originally made with finger-holes only, and these were of necessity small in diameter compared with the calibre of the tube. The instrument for convenience of handling was made of a double S form

and by degrees, holes covered by padded keys took the place of, and also supplemented the finger-holes. The basson Russe, or bass horn, and the ophicleide, each of which has had its own day, are merely modifications of the serpent, and introduce no new principle. The key, or Kent bugle, is the treble instrument of this family, and before the introduction of the piston-valve, was an important feature in a military band.

In all these instruments, pierced with side-holes covered either with the fingers, or by keys, a chromatic, or in some cases merely a diatonic scale was obtained through shortening the tube by successive steps. In those we now have to consider, the opposite principle, that of increasing the normal length by successive steps, is brought into play.

The oldest and in some respects the best method of altering the length with sufficient promptness for musical purposes, is the double telescopic slide fitted to the cylindrical portion of the instrument. Ths slide enables the player to flatten his instrument to the extent of seven semitones as from C to F sharp. Each of these seven "positions" is the basis of a separate harmonic series, and by this means a complete chromatic scale can be built, from the second tones of the series upwards. The principle of such a slide is excellent, but its application is limited to instruments with a large proportion of cylindrical tubing, and therefore of a certain tone quality. Instruments of the conical or bugle type are excluded, and it is this large family to which the modern valve system is peculiarly applicable. The valve, whether of the "piston" or "rotary cylinder" type is so arranged that on its depression in the one case, or quarter revolution in the other, a certain extra loop of tubing is brought into the effective length of the instruments. In a three-valve set, the extra lengths thus introduced are respectively, one, two, and three semitones, and by using the valves in combination, the series of added lengths can be extended to agree with the seven "positions" on the slide trombone. To the larger bass instruments, a fourth valve, giving an interval of fourth, as from C to G, is very generally added. When valves are used in combination, however, the note is usually slightly and, in certain cases, considerably sharp, and the reason for this can be easily understood. If a valve is adjusted to flatten an instrument a third, as from C to A, a second valve adapted to alter the pitch a tone, from C to B flat, cannot also give a true tone, when the instrument has already been lengthened or flattened from C to A by the depression of the first-named valve, for the added length for a given interval should always be in a certain ratio to the lengt of tube already in use. This difficulty has long been known, and many arrangements have been designed to overcome it; one system of valve action with this object in view was designed by me about thirty years ago for Messrs. Boosey and Co., and is now very generally known as the compensating piston.

The total range of compass in brass instruments is about one octave greater than the whole range of the human voice, and this extra octave lies below the bass voice. A fairly good cornet player can give the high A or B flat of the soprano voice, and an exceptional player can go two or three tones higher, just as the exceptional singer can do, while a bass tuba player can take the E flat or D an octave lower than the lowest notes of the bass voice.

By means of a pressure-gauge, first used, I believe, by the late Dr. W. H. Stone, it is possible to measure the pressure in the lungs when blowing instruments, and although there

is no particular interest in observing the maximum limit, an interesting point may be noted as regards the lower limit. For any given series of notes, this appears to be directly proportional to their vibrational frequencies, and for a note of any particular pitch, to be independent of the size of the instrument.

[These points were shown by experiment.]

The lecture was illustrated by lantern slides of plates from the following works:—Sebastian Virdung, Musica, Basel, 1511; Michael Praetorious, Syntagma, Wolfenbüttel, 1618; Georges Kastner, Manual Général de Musique Militaire, Paris, 1848.

MEMORIAL TABLETS.

It is thought that it might be interesting for the members to have an opportunity of comparing the memorial tablets adopted by the Society of Arts, and by the London County Council, so a representation of the two tablets is given herewith.

The London County Council tablet is one put up by the Council to Sir Robert Peel, at 4, Whitehall-gardens.

The Society of Arts tablet is one erected on Bolton-house, Windmill-hill, Hampstead, lived in by Joanna Baillie.

The London County Council tablet is in blue. Most of those put up by the Society of Arts are in red, though some of the older tablets are in blue. The same tablet has always been used by the Society since the first one, which was erected on Byron's house in Holles-street, in 1867. This tablet was taken down when the house was altered, and a large medallion was substituted by the owners of the premises, Messrs. John Lewis and Co.

It has not been easy to ascertain precisely who was responsible for the design of the Society's tablet. The original proposal for the erection of memorial tablets was due to Sir Henry Cole and Mr. (now Sir) George Bartley, in 1864. When the idea was first taken up, the offer of a £10 prize for a suitable design was made, but nothing seems to have come of this. Later on, Mr. Bartley undertook to obtain a design, and with the assistance of Sir Henry Cole, who took a great interest in the matter, various designs were

prepared in the offices of the Science and Art Department under the late Mr. Godfrey Sykes and his assistant. Eventually the matter was placed in the hands of Messrs. Minton, Hollins and Co., of Stoke-on-Trent, who appear to have worked on the suggestions submitted to them, and produced the tablet which was approved and adopted by the Council of the Society.

One of the main objects in the design was that the Society of Arts name should be given, but that it should not be made too prominent, and this object was effectively attained by the ingenious border in which the name of the Society is introduced.

The same design has in all cases been used by the Society, with the solitary exception of the tablet to Milton in Bunhill-row. The architecture of the building there did not admit of the convenient erection of a circular tablet, and consequently the oblong tablet which is now in position was specially designed and erected.

THE NOTTINGHAM LACE TRADE.—MASTERS AND MEN.

For a long time past, the lace manufacturers of Nottingham have been at variance with their workmen. The masters insisted upon lower rates, the men refused to accept them; the masters said it was impossible to go on paying current rates, the men said that all that was necessary was to replace obsolete by

efficient machinery. "If," said the last half-yearly report of the Nottingham Operative Lacemakers' Society, "steps are not quickly taken to replace the obsolete machines by modern ones, Nottingham will very soon bid farewell to that predominating influence over the manufacture of lace which it has held for a century." After much discussion, a revised price list, effecting considerable reductions, was unanimously agreed upon by a joint committee composed of members of the men's Association and the manufacturers' Association, and an agreement had previously been arrived at by both parties that any dispute which they were unable to settle themselves should be referred to the arbitration of the Board of Trade, whose decision should be final. Unfortunately the men repudiated the action of the joint committee, and the manufacturers having served formal notice of their intention to put the revised price list in operation on the 17th instant, the men resolved to cease work. It is not the first time in the controversy that they have refused to follow their leaders.

There can be no question that the lace trade of Nottingham, so far as the making is concerned, is in a bad way. It is passing to Long Eaton, Beeston, Ilkeston—and the Continent. Long Eaton boasts of more than half the number of lace machines working in the district round Nottingham, and more than half the number of operatives working in Nottingham itself. It is the contention of the manufacturers that the trouble in Nottingham is due to the cast-iron methods adopted by the Lacemakers' Union. The manufacturers say that these methods have all tended to drive trade away from the town. Long Eaton has been built up by men who have gone there to escape unreasonable demands, and they give an illustration. At one time there was a run on a certain kind of black lace, and the men who made it were paid a special rate because the work was trying to the eyes, and they could not turn out the material at such a fast rate. Then the demand slackened, and one manufacturer who had some white lace to make that he knew would have to be dyed black, wished to run a few of the black threads that had been left on his hands into the material. But the men refused to carry out the work unless they were given the higher rate. The conditions in the outside districts are quite different. In Nottingham the machine-holders have stuck to their old narrow frames; in Long Eaton they have the best up-to-date machines, both in width and producing capacity, and the auxiliary workers are more numerous, and attend so fully to the needs of the actual operatives that there is the minimum of time wasted. The result is that some of the machines make 300 racks, and even more, per week. The employers can afford to have the extra workers because they are free of the dictation of the Nottingham society. All is done to obtain the most the machines can turn out, and so the lacemaker can afford to work for less per rack than in Nottingham, and still get a bigger weekly wage. In Nottingham, a man who stayed behind at one o'clock (the dinner hour), would be censured by his fellow operatives; at Long Eaton, he may please himself, and it is seldom that men stop their machines for a meal. Almost all the machines running at Long Eaton are of the new wide pattern, and though rates are much lower, wages are better than in Nottingham. In Nottingham, 11d. per rack is paid, at Long Eaton, the extremes in prices are from 5½d. per rack to 7½d. and 8d.

The extent of the migration of laceworkers from Nottingham to the other districts may be gathered from the following figures, taken from an interesting pamphlet recently published by the *Nottingham Daily Express* on "The Lace Trade in Nottingham and District," and showing the number of machines and men working in what are known as "outside districts":—

MACHINES.

	Levers.	Curtains.	Plain Net.	Total.
Long Eaton......	800	—	—	800
Beeston...........	124	37	—	161
Ilkeston	107	30	—	137
Sandiacre.........	114	24	52	190
Southwell.........	—	57	—	57
Other Places ...	—	—	—	250
	1,145	148	52	1,595

MEN.

	Levers.	Curtain.	Plain Net.	Total.
Long Eaton......	1,200	—	—	1,200
Beeston...........	193	42	—	235
Ilkeston	131	51	—	182
Sandiacre	160	40	66	266
Southwell.........	—	101	—	101
Other Places ...	—	—	—	425
	1,684	234	66	2,409

PROPORTION OF UNIONISTS.

	Levers.	Curtain.	Plain Net.	Total.
Long Eaton......	74	—	—	74
Beeston...........	104	40	—	144
Ilkeston	100	51	—	151
Sandiacre........	26	—	50	76
Southwell.........	—	55	—	55
Other Places ...	—	—	—	49
	304	146	50	549

It is not possible to obtain the number of machines working in Nottingham, but at the end of last year it was computed that the total Nottingham membership of the society was 2,805, of whom 2,214 were actually working, so that there were fewer operatives employed in Nottingham, the so-called lace town, than in the other districts.

The Nottingham manufacturers complain bitterly of trade union interference, but the men argue

that the fault of the present state of the industry in the town is more with the manufacturer than wtih themselves. He will not supply himself with up-to-date machinery. As to that, Mr. Ernest Jardine, of the great firm of machine builders and merchants of that name, writes:—"We have been making bobbin pressing machines which do the work with one-tenth of the labour in a quarter of the time occupied by the old method. It makes a perfect fit, and it is impossible to spoil the bobbins. We have put in 50 of these at Long Eaton alone. We claim that a manufacturer having these machines can save more than the total cost in the first year. We have offered to put in these machines in Nottingham free of charge, and at the end of three months, if they are not wanted, to remove them. We have succeeded in placing two at Nottingham." At Long Eaton, double handed, they will make 300 racks per week; in Nottingham, 175 or 185 racks is considered a capital week's work.

It is not only the outside districts with which Nottingham has to reckon. Continental competition has become very formidable, more particularly that of Germany and Switzerland. It has been said that nine-tenths of the lace goods exhibited in the windows of Nottingham shopkeepers is made on the Continent. Probably that is an exaggeration, but the "Schiffchem" and the "Barmen" machines, to be found principally at Plauen, in Saxony, and St. Gall, in Switzerland, have played havoc with Nottingham. There are between 3,000 and 4,000 of the Schiffchem machines in Switzerland, they all make the best class of goods, and every one has been made within the last ten years. In addition, there are thousands of hand machines at work in St. Gall and the villages around. At Plauen, the competition is even more formidable. The people there have devoted themselves almost entirely to the manufacture of lace. In Saxony, there are 3,000 machines, most of them making lace. Some few Nottingham firms fought hard against the foreign invasion. One firm when they found that Edelweiss lace was coming into the English market, obtained three machines from France, and made the same goods. Each machine, however, required a very skilful pantographer, whose duty it was to trace the pattern whilst the apparatus was at work. These men could only have been got from Germany or Switzerland, and the manufacturers there had entered into a compact for the purpose of preventing any of their workmen from leaving the country. It is said that last season, when lace collars were being worn by every girl, not more than 150 machines in Nottingham could have made such articles. In Switzerland alone there were between 2,000 and 3,000 machines capable of turning them out.

It is not surprising that under the circumstances narrated the lace making, as distinguished from the lace finishing trade, is leaving Nottingham for the outside districts, more especially Long Eaton, and the Continent. Opinions differ as to whether it can be recovered, but it may be said with confidence that recovery is only possible if masters and men mend their methods, if the masters become more alive to the need of up-to-date machinery, and the men free themselves from the present crippling conditions of service.

*THE RELATION BETWEEN POPULATION AND AREA IN INDIA.**

The term "density" may be applied to population in a sense merely numerical, or it may be taken to involve the economical consideration of relation to the means of subsistence. Used in the latter sense, with reference to a population producing the food it consumes, the determining factor is practically the fertility of the local resources. India comes under this head. Its population is mainly vegetarian, and the greatly predominating occupation is agriculture. In analysing the distribution of its population, therefore, the first consideration is the relative fertility of the varions tracts, and using the geographical divisions of the country as the base and remembering that tropical conditions prevail, the essential feature to be taken into account is the rainfall. Speaking generally, the concentration of population tends to vary directly as the rainfall, and inversely as its seasonal variability. There are several important instances in which this tendency is not apparent, but here it is kept in abeyance by special circumstances, such as unhealthy climate, political disturbances, or paucity of cultivable land on the one hand, and on the other by exceptional facilities for supplementing the rainfall by artificial irrigation.

There are few countries of any considerable size so uniform in the distribution of their population that the figure of their average density serves any purpose but that of the very broadest comparison, and its chief use in statistics is as a screen on which to illustrate its component variations. In India, with its unusual range of climatic and geographical variety, the average is peculiarly meaningless, and, compounded as it is largely from its two extremes, the density it implies actually prevails over but a comparatively small proportion of the area which contributes to it. The urban element in the population, again, enters but to a trifling extent into the calculation, as is only to be expected in a country so markedly agricultural in its pursuits and so largely self-supporting. As a rule, the most densely peopled tracts, except just round the large industrial seaports, are remarkable for the paucity of their urban aggregates beyond the size of the ordinary local market town. There are, on the other hand, parts of the country, especially in Native States, where a comparatively large town is found in the midst of a very thinly populated neighbourhood, to which it serves as a centre of commerce. The political and military considerations which used to determine the situation and

* Abstract of paper read by J. A. Baines, C.S.I., before Section F of the British Asociation meeting at Cambridge.

prospects of an important town are now superseded almost everywhere by those connected with transport and manufacture. ~~Except, however, along the coast~~ and trunk lines of railway, the smaller urban centres prosper and wane with the fortunes of the surrounding peasantry.

The nature and extent of the shifting of the distribution of population of late years are subjects upon which the recent famines have made it difficult to reach satisfactory conclusions, nor were the exceptionally favourable circumstances of the preceding decennial period much more instructive. At best the rate of growth in the long-settled tracts does not appear to be other than moderate compared with that prevailing elsewhere, but the evidence of a state approaching congestion is not altogether convincing. Between 1881 and 1891, the most thickly peopled tracts showed a rate of increase very much below that of those with a more scattered population, but it is not improbable that in the latter the later census was far more accurately taken, so that much of the growth must be discounted accordingly. On the other hand, during the last decennium, the denser tracts showed, on the whole, a higher rate than the rest; but here, again, allowance must be made for the fortunate immunity from famine enjoyed by the former, as also for a certain multiplication of the means of subsistence which has characterised some of them.

On the whole, it appears certain that under present conditions any increase in population that occurs will fall directly upon the land, and in most parts of the country the means exist for meeting that pressure, at all events for some considerable time. Cultivable land not yet taken up is found in most provinces and States. In some comparatively remote regions this area is large and continuous, and is now being placed within reach of immigrants by the extension of railways. Elsewhere the sinking of wells has intensified the cultivation, and the introduction of additional water supply by means of canals has rendered large areas productive which were before sterile. Congestion may be thus staved off for a generation, but must come, as the line of increase remains the same. There are, however, signs of the beginning of a process of diversion from agriculture to other industries. The urban population has recently shown a tendency to increase at a slightly higher rate than the rural, and though in the famine-stricken tracts this may be in part attributed to the traditional tendency of the field labourer to wander towards the doles and labour market of the nearest town, the growth of the seaports and manufacturing centres testifies to a real movement away from the fields. Whether the movement be permanent or, as in many cases it is known to be, merely seasonal, there is no doubt as to the increased advantage which is being taken of the openings afforded by the development of new undertakings within the last twenty years or even less, and the villager earns away from home more than the subsistence he used to himself produce there. The further step of emigration for employment out of India and its immediate neighbours is an outlet which also shows signs of expansion, but, like the migration to the plantations or factories, it is a matter of sentiment and custom, and once acclimatised, often leads to a regular flow out and back. That the returned emigrant's savings are ultimately invested in the purchase of land in his birthplace is a matter that will have to be taken into account by the next generation.

ALCOHOLIC BEVERAGES AT HOME AND ABROAD.

Some interesting statistics have recently been prepared by the United States Department of Commerce and Labour bearing upon the question of the consumption of spirits, wine and beer, for the latest available period, in the principal European countries and in the United States. In the United Kingdom the amount consumed works out as follows:—Spirits, 58,318,000 proof gallons; beer, 1,500,710,000 gallons, and wine, 16,646,000 gallons. In the United States the figures are 117,252,000, 1,449,879,000 and 38,720,000; in Germany, 124,313,000, 1,782,778,000 and 113,583,000; in Russia, 172,530,000, 151,633,000 (for wine there are no statistics of consumption in this country). In France there are 97,178,000 proof gallons of spirits consumed, 289,103,000 gallons of beer, and 1,342,830,000 gallons of wine; the corresponding figures for Sweden are 10,730,000, 44,440,000, and 808,000; for Belgium, 9,895,000, 395,285,000, and 8,948,000; and for Italy 11,150,000, 6,726,000, and 1,045,961,000. In the case of European countries the figures for spirits include only those quantities which are used in the form of beverages, the quantities used in the arts and manufactures being uniformly excluded. There are no exact data for the United States, as all the spirits entering domestic, including industrial consumption, are taxed at a uniform rate. Authoritative estimates place the quantity used in the arts and manufactures in the United States at about 10,000,000 gallons. As regards the *per capita* consumption France shows the heaviest consumption of the most concentrated beverage, spirits, viz., 2·51 gallons per inhabitant, the other countries following in the order of their *per capita* consumption being Sweden, 2·13; Germany, 2·11; Belgium, 1·42; United Kingdom, 1·38; United States, 1·33; Russia, 1·29, and lastly Italy with only 0·34 gallons. The *per capita* consumption of spirits in the United States is 1·33 proof gallons. Statistics of the average consumption of beer per head of the population reveal the fact that Belgium stands at the head of the nations, the *per capita* consumption being 56·59 gallons; second in order is the United Kingdom with 35·42 gallons, while Germany, which shows the largest absolute figures of consumption in

the matter of *per capita* consumption, takes third place with 30·77 gallons. The United States follows with 18·04 gallons, Sweden and France with 8·83 and 7·48 gallons, Russia, 1·13 gallons per inhabitant, while Italy is still lower, viz., 0·20 gallon. The consumption of wine may be said to be concentrated in two countries, chiefly France and Italy, both the absolute and *per capita* consumption showing that wine in these countries is a common article of consumption showing that wine in these countries is a common article of consumption rather than an article of luxury, used only by the favoured few. The figures of *per capita* consumption of wine in these countries—34·73 gallons in France and 31·86 gallons in Italy—are almost identical with those shown for beer by the United Kingdom and Germany. The consumption of wine in other countries is relatively insignificant, only Germany with 1·93 gallons per inhabitant, and Belgium with 1·28 gallons, showing a *per capita* consumption exceeding one gallon, the estimated *per capita* consumption in the United States being 0·48 gallons. The following figures will show the total quantity of alcohol of 50 per cent. strength consumed in the form of beverages in the countries named, beer and wine having been expressed in terms of spirits of standard (*i.e.*, 50 per cent.) strength by assuming an average alcohol content of 5 per cent. for beer and 10 per cent. for wine. Reduced, as it were, to common terms, the consumption of alcohol of 50 per cent. strength as beverages in the countries in question is as follows: United Kingdom, 211,718,000 gallons; France, 394,654,000; Germany, 325,307,000; Italy, 221,015,000; Russia, 187,713,000 (consumption of wine not included); Belgium, 51,213,000; Sweden, 15,354,000; and the United States 259,984,000 gallons. In the latter case 10,000,000 gallons of spirits used in the arts are excluded. France shows the largest *per capita* consumption of alcoholic beverages, viz., 10·21 gallons, while Belgium, owing to its heavy beer consumption, follows next in order with 7·33 gallons. Italy with 6·61 gallons, Germany with 5·53 gallons, and the United Kingdom with 4·99 gallons are the older countries which may be said to excel in the consumption of alcoholic beverages. The United States with 3·23 gallons, Sweden with 3·05 gallons, and Russia with 1·39 gallons of average consumption wind up the list of the countries in question.

COMMERCIAL EDUCATION IN JAPAN.

Within the last decade, the most important commercial nations of Europe have discovered the importance of higher theoretical commercial education, and have established institutions devoted to commercial studies, thereby acknowledging this system of education to be of equal value to that afforded by the universities. At a much earlier period, Japan devoted attention to this important branch of education. Commercial schools were established in an almost incredibly short time. As early as 1873, the first commercial institute was established in Tokyo. Since that time, similar schools have been established in various parts of the Empire. In 1884, the commercial schools were regulated by ministerial decree, and in 1899 a general law was passed concerning commercial educational institutions. In accordance with this law, the commercial schools are divided into two categories:—(1) The schools of the first class take students in their fourteenth year, after they have graduated from a four year old course in a higher ordinary school, and demand a knowledge, of at least one foreign language. They offer a three years course, which may be increased by one year if necessary. The number of hours of school work per week which may be increased by one week, which may be taken by a student, shall not exceed thirty-three. (2) In the schools of the second class, instruction continues for a period of three years. Pupils of ten years of age may enter, and the number of hours of school work shall not exceed thirty per week. Above the commercial schools of the first grade, stand the commercial high schools, so that Japan has, in fact, three grades of commercial schools which differ from the usual European schools, in that they are built one upon the other. This difference has an influence upon the thoroughness of education, since a student who has passed through the series of schools, and has put in eight or ten years' study in commercial branches, must be better equipped than one who has had only two or three years' preparation. At present there are commercial high schools at Tokyo, and at Kobé. The one at Tokyo was founded in 1875, by Viscount Mori, as a private school. In 1887 this school was re-organised, under the title Koto Shogyo Gokko, and it adopted some of the methods of the Ecole des Hautes Etudes Commerciales of Paris, and the Institut Supérieur de Commerce of Antwerp. The business men of Japan were not altogether friendly to the system, because they preferred to take young men without much training, and mould them as they desired. The school at Tokyo has endeavoured to prove its value to Japanese commercial circles, and it has had the assistance of a committee of leading merchants, bankers, and State officials. There are three courses available, a preparatory course of one year, a course of three years, and a graduate course of two years. The preparatory course includes the following studies:—Japanese writing, Japanese composition, mathematics, book-keeping, technology, practical physics, general law, general economics, English, French, German, Russian, Spanish, Italian, or Korean languages, gymnastics, and military exercises. The higher course includes the following studies:—Economics, Japanese commercial law, comparative international commercial law, commercial composition and office management, economic relations of Eastern Asia, history of the relations of the foreign powers, criminal law, English

composition, and other foreign languages. In the professional division of the higher course the student may also choose work in connection with commerce, railways, banking, shipping, insurance, and the consular service. The students in this course have to pass an examination and prepare a dissertation on some subject relating to commerce to enable them to gain the title of "doctor of commerce." Notwithstanding the rapid progress Japan is making, it is evident to those interested that there is a necessity for greater attention to foreign languages. In 1897, by Imperial decree, the study of languages in the school was made independent. The instruction extends over three years, with twenty-four hours weekly in English, German, French, Russian, and Spanish, and twenty-seven hours weekly in Chinese and Korean. The affairs of the school are managed by a committee on education, which includes representatives of the Minister of Education, and leading business men, as well as the director of the school. The immediate supervision of the school is in the hands of the director. The faculty consists of fourteen ordinary professors, twelve head professors, and seven secretaries. In the college for foreign languages there are fifteen ordinary professors, eight head professors, and three secretaries. In this school and that at Kobé there are from ten to fourteen foreign professors almost continually at work in the foreign languages department. The sample office is also in charge of a foreigner. In course of time these professors are to be replaced by Japanese. In connection with the commercial high school there is a commercial museum, containing a collection of various wares. In 1890 the school went into its new building, which was erected at a cost of £29,000. In 1889 steps were first taken to establish a commercial high school at Kobé. The organisation and the lecture course correspond to those of the school at Tokyo, but the preparatory course extends over only one year, and there is but one other course of three years. The main difference between the schools of Kobé and Tokyo consists in the separation of the prepatory course at Kobé into two departments, the first for pupils of middle schools and the second for pupils of the commercial middle schools.

CUBA AND BRITISH TRADE.

A report from Mr. Lionel Carder, His Majesty's Minister at Havana, upon the trade and commerce of Cuba, has just been issued, and is of exceptional interest. It shows that the island has recovered from the ravages of civil and foreign war, and that very considerable economic development may be expected in the early future. Mr. Carder thinks it probable that the value of the imports in 1905 will be at least £21,000,000, or 65 per cent. more than in 1903. The production of sugar is now as large as in the best year before the insurrection, and the steady increase in the output must mean increased employment for British vessels. If, too, the cultivation of cotton assumes the proportions expected, further stimulus will be given to the British shipping engaged in the direct carrying trade by increasing opportunities for getting return cargoes. Experiments, some of them on quite an extensive scale, have shown that a superior class of cotton can be raised in Cuba. The only question remaining in doubt is whether there is sufficient labour available at reasonable prices for pulling the cotton if planted in considerable quantity. If this difficulty can be got over—and labour is the crux of the cotton question—there is every reason to expect that the cotton industry in Cuba will soon come to be of great importance. If so, large shipments will be made to the United Kingdom, thus increasing the commercial movement between the two countries, and greatly benefiting the direct carrying trade in British bottoms. The variety of cotton found to grow best in Cuba is Sea Island, which is of fine quality and long staple.

The imports from the United Kingdom and British possessions show a satisfactory increase, not only in amount but in the proportion they bear to the total imports which is now 20 per cent. as against 18 per cent. in 1902 and 15 per cent. in 1901. The following figures show the position:—

Country.	Value.		Proportion.	
	1902.	1903.	1902.	1903.
United States and Possessions	£ 5,156,120	£ 5,525,806	Per cent. 42½	Per cent. 41½
United Kingdom and British Possessions	2,175,664	2,542,845	18	20
Spain	1,908,332	1,822,707	15¾	14½

By far the largest increase, amounting to £354,000, occurred in textile goods, after which came metals and machinery, coal and coke, and manufacturers of leather, with respectively £156,000, £147,000, and £106,000. A large proportion of the textile goods comes from the United Kingdom. The value of the exports in 1903 increased more than £2,500,000 as compared with 1902, but there was very little difference in the proportions.

Country.	Value.		Proportion.	
	1902.	1903.	1902.	1903.
United States and Possessions.. ...	£ 9,901,128	£ 12,010,396	Per cent. 77	Per cent. 77¾
United Kingdom and British Possessions	1,302,657	1,485,712	10	9½
Spain	212,978	254,641	1¾	1¾

With the increase of wealth there is likely to be a largely increased demand for textile goods. The coloured population are fond of dress, and spend their money freely in such articles when they have

it. This would of course benefit British trade more largely in proportion than that of any other country. Mr. Carden thinks there is want of enterprise on the part of British manufacturers, and he relates the following incident in support of his contention. The Minister had received a letter from a British manufacturing firm asking him to assist them in placing on the Cuban market an agricultural appliance which, if capable of giving the results claimed, would create almost a revolution in cultivation in Cuba. Mr. Carden referred to a gentleman of very high standing, who was especially well qualified to bring it to the notice of Cuban planters. He was favourably impressed with its possibilities, and wrote to the firm offering, if they would send out one of the machines, to pay all the expenses and give it a good trial. To this they replied that the only terms on which they could send one out would be those of purchase, adding that the demand for the machine was so great that it was impossible for them to cope with it, an observation that only admitted the inference that their correspondent must consider himself as very fortunate to have the opportunity of buying one at all. This was the end of the matter, the impression left on the Cuban gentleman's mind being that the manufacturers were quite indifferent as to whether they did business or not. Mr. Carden adds that the machine was an expensive one, costing in the United Kingdom £200, and if, after being properly tested, it had proved suitable to the conditions of soil and climate prevalent in Cuba, there is little doubt that a very large market could have been opened up for it in Cuba.

BRITISH TRADE IN SWITZERLAND.

Switzerland's best customer is Great Britain. Of the exports of principal Swiss manufactures in 1903 the United Kingdom and her Colonies took more than 27 per cent., and the Swiss are anxious to do more trade with us. In his exhaustive report on the trade of Switzerland for 1903, just issued, Mr. J. C. Milligan, who is British Commercial Agent in that country, says, "There is at the present time a very great desire among the leading Swiss merchants, which has also found expression in the Swiss Press, that both the United Kingdom and France should have a larger share of Switzerland's market." Why is it then that the British share in the supply of Switzerland's requirements of manufactured goods for home consumption only amounted last year to 10·9 per cent.? If the imports of cotton goods from the United Kingdom, which accounts for as much as 56 per cent. of the British exports of manufactures to Switzerland, are left out of consideration, the unsatisfactory condition of the export trade of the United Kingdom to Switzerland becomes more apparent. To quote Mr. Milligan, "Germany has by far the greatest share in the Swiss trade. In the year under review the exports from Germany to Switzerland of finished goods amounted to £8,026,000, or if the value of her cotton exports be deducted, £677,000, we have a total of £7,349,000 for all other classes of of manufactures. The United Kingdom supplied cotton goods to the value of £921,900 to Switzerland, and on deducting that amount from the total exports, her share in all classes of finished goods amounted to only £719,600, against, as already stated, £7,349,000 supplied by Germany, and £2,478,000 supplied by France." Mr. Milligan points to the bicycle trade. During the last five years nearly 74,500 machines, representing a value of £655,000, have been imported into Switzerland, of which 49,500 came from Germany, 12,500 from France, 6,000 from the United States, and 1,700 from the United Kingdom. The imports are increasing yearly, last year's total of 17,170 machines being the highest, but the imports of British bicycles steadily dwindled until 1903, when there was a slight recovery. Mr. Milligan says some very useful information has been given to him by a large Swiss dealer with regard to the cycle trade in Switzerland, which he will supply to any British manufacturers interested if they will apply to him. British prices seem to be too high for the Swiss. Many British manufacturers do not seem to be aware of the commercial position which Switzerland occupies among the other markets of the world, or know that she has a demand for such a large value of imported manufactured goods. British trade with Switzerland is not pushed like that of other countries. "If," writes one of the principal journals in German Switzerland, "British manufacturers would only follow the advice of the British Commercial Agent, and copy the Germans, Italians, and other nations, in opening up relations with Switzerland, their exports would most certainly increase. There is no reason why we should give German and French commercial travellers the preference if the goods are equal in finish and price." The difficulty is that British commercial travellers are less well equipped for getting business. If it is not possible to send commercial representatives possessing a knowledge of German and French, Mr. Milligan suggests the appointment of local Swiss agents, able to correspond in English.

AUSTRALIAN FORESTRY.

The importance of forest conservation is beginning to receive increased attention in the Commonwealth, where the revenue from the various State forest lands remains considerably below that obtained in countries possessing far less wealth of timber. In New South Wales the forests, contrary to the popular idea in Europe and America, extend over almost the whole area of the State, excepting portions of the Monaro, Lachlan, Murrumbidgee districts, and the trans-Darling region, where extensive treeless plains occur, clothed with salt-bush, scrub, or species of natural grasses. There are at the present time nearly six and

a-half million acres of forest reserves in the State. In South Australia there are nearly 200,000 acres of forest reserves and plantations; in Queensland, where forest conservation is of recent date, the reserved areas form a total of over three million acres; in Victoria the forest reserves cover a total area of 4,679,540 acres out of 11,797,000 acres of forest country, the balance being mostly timber country difficult of access; in Western Australia a beginning has been made by establishing forest reserves forming a total of over a million acres out of an estimated total of 20,000,000 acres; while in Tasmania about 33,300 acres have been reserved for timber-planting and growing. The total area of forest land in the latter State is about 4,000,000 acres, and it has been estimated that the forest lands of the Commonwealth cover an area of over 60,000,000 acres. The trees met with are chiefly species of eucalyptus, angophora, and other genera of the order myrtaceæ. The prevalence of the eucalypti, and the large extent covered by the forests, give the country a rather monotonous aspect; but the park-like appearance of the open forests, and the beauty of the many flowering shrubs, win admiration in spite of the sameness of the trees; while even the dull, greyish blue of the foliage of the gum trees, when relieved by the yellow blossoms of the wattle, including the graceful myall, or the beautiful and shapely kurrajong, is not without its attractiveness. The trees are, for the most part, straight and cylindrical in the trunk, and when full grown, their first branch is at a considerable height from the ground. The roots of the eucalyptus often lie at no great distance from the surface soil, an adaptation of nature to the peculiar climatic conditions of the country. The finest specimens of many of the timber trees, those yielding the most valuable timber, are found on ridges and hill sides, in places frequently too rough and stony for cultivation. In Western Australia the most valuable indigenous timbers are the jarrah, twart (or torart), sandal-wood, karri, and several others. In Queensland cedar timbers are abundant, also in the northern portions of New South Wales, some of the logs obtained being of enormous size. One characteristic feature of Australian hard-wood trees, of which there exists an almost endless variety, is the great size of the beams which may be obtained from them, as well as for the extreme toughness and durability of their wood; the grey ironbark having a resistance to breaking eqnal to 17,900 lb. per square inch, as compared with a mean of 11,800 lb. for English oak, and 15,500 for teak. None of the other timbers have so high a resistance to breaking as this description of iron-bark, but nearly all the varieties have a greater strength than oak. The quality of the wood is materially influenced by the soil on which the trees grow, while the absence of branches for the greater portion of the height enables the timber to be obtained to the best advantage; and as full-grown trees of most varieties are rarely less than 100 feet high, with corresponding girth, the quantity of timber obtainable from the virgin forests is very large. In New South Wales the timbers of commercial value, many of which are found in the other States, include white or she-ironbark, narrow-leaved ironbark, broad-leaved ironbark, mugga, or red iron-bark, blackbutt, white mahogany, tallow-wood, spotted gum, grey box, red mahogany, grey gum, forest red gum, Sydney blue gum, and turpentine, the latter resisting the attacks of white ants. One of the most useful trees is the red cedar, the wood of which, somewhat resembles mahogany, is well adapted for the finer kinds of cabinet-makers' work. Some of the cedar trees grow to immense size, as much as 2,500 cubic feet of valuable timber having been obtained from a single tree. Many of the woods of the minor trees are beautifully grained, and capable of receiving the highest polish, while others are fragrantly perfumed. These woods are adapted to the finest description of cabinet-making, and it is strange that their merits should have so long escaped attention. Amongst these trees may be mentioned the rosewood, tulipwood, yellowwood, white maple, white beech, myall, marblewood, mock orange, and many others. Besides their use for cabinet-making, many of the brush timbers are of great utility for the rougher kinds of carpentry; while some, both hard and soft woods are admirably adapted for coach-builders' and coopers' work. "Colonial deal" is an excellent timber. and is obtained in very large scantling, the tree frequently reaching 120 feet in height. It is soft, close-grained, easily wrought, and remarkably free from knots. Its use, therefore, is extensive for cabinet-makers' work and house fittings. The value of the exports of Australian timber, dressed and undressed, from Commonweath ports in 1903 was £745,490, of which the undressed timber, chiefly from Western Australia, represented £739,317.

CORRESPONDENCE.

STREET ARCHITECTURE.

In the course of the paper read by Mr. Jackson last week, he said, "Foot passengers, however, do not run very much against one another, and need never do so if everybody observed the rule of the footway, and to help this he would put up "direction labels—'Keep to the Right.'" I do not think this is good advice, because the natural inclination of 75 per cent. of foot passengers is to bear to the left, and I believe all would but for a desire to conform to what is expected of them. It is this wrong existing rule, coupled with the stupidity of two or more persons sianding in the middle of the pavement talking together, that renders locomotion so irritating and slow.

G. G. MACWILLIAM.

20, Bartlett's-buildings, Holborn-circus, London, E.C.,
December 26th, 1904.

The last number of the *Builder* contains the following remarks on Mr. Jackson's paper on "Street Architecture":—The often-vexed question of grouping and symmetrical design in street architecture, as against the effect of individuality, or independent treatment for each property, naturally comes up once more; and we are glad to find that Mr. Jackson recognises the importance of symmetrical architectural treatment, if he does not advocate it in all cases, and he commented strongly on the manner in which the design of Regent-street, "the one fine and consistent piece of street architecture in London," has been practically destroyed by the intrusive alterations which have been permitted to be made in it." To call Regent-street, in its original state, "fine" architecture is what we should hesitate to do *sans phrase*, but "consistent" at all events it was, and has now ceased to be so, and people are beginning to find, when it is too late, that they have destroyed something which was of architectural value to London. Regent-street would have been respected had it existed in Paris. An owner of one or two houses in the Place Vendôme wished some little time ago to raise them, thereby spoiling the architectural design of the square: he was not allowed to do so.

Our own opinion is that massing of street architecture, if not for a whole street, at all events in large blocks, in a symmetrical design, is an almost necessary expedient if the highest dignity is to be given to the architecture of a city. It is owing to the prevalence of this symmetrical street architecture that Paris has that grandiose air which makes it seem a city so much more, in the full sense of the word, than our own capital. Of course it may be said that the Paris street architecture is somewhat cold and formal and wanting in variety; so it is, but something must be given up either for the picturesque on one side or the stately on another; and to our mind it is the stately element that is most proper to a capital city, at all events. The manner in which the County Council have let slip the opportunity for stately and symmetrical design in Aldwych and Kingsway, after laying the foundation for it by instituting a competition for designs, is absolutely lamentable. The mischief is done now in Aldwych, but there is still some place for repentance in regard to Kingsway.

The demand for special treatment and special material for shop front architecture was rather more emphasised by Mr. Jackson than we should have expected. He urged that was no reason why stanchions and bressummers should not be treated architecturally if there was an absolute demand for entirely glazed shop fronts.

We do not think that steel bressummers and stanchions are as capable of as much architectural effect as stone piers and arches, though we quite agree that if that glass ground-story is indispensable, the means of supporting the building above it should be openly shown, and treated in a way characteristic of the material; and it is too true that this is very seldom done at present, and we see arches or imaginary stone lintels, that could not possibly stand put up in order to comply with what are supposed to be the demands of architecture. That of course is all wrong; and visible steel structure is much better than sham stone structure. But, after all, real stone structure is better than either; and whatever the "honesty" of the steel construction, we have still the disagreeable effect of the empty space as the base of an architectural design. But the question is, whether people are not getting hold of the whole matter the wrong way about. Is it really necessary to the prosperity of a shopkeeper that he should have the whole front of his shop scooped out and filled with plate glass? Is it not merely a superstition of the trading mind? And is it not possible to convert the shopkeeper to a perception that a dignified architectural masonry front, even if arched, is worth more to his trade than filling up the spandrels with glass?

Mr. T. G. Jackson communicated the following letter on the Strand improvements to *The Times*:—

The notice which appeared in *The Times* of my address at the Society of Arts on the 20th inst., and the attention it has received from some of your contemporaries, encourage me to ask for an opportunity of continuing in your columns the subject of the Strand improvements.

Out of many suggestions for a frontage line between St. Mary's and St. Clement's churches, the London County Council has chosen the cheapest and the worst. The frontage line now laid down lies at a very awkward angle with St. Mary's Church, and when produced cuts into the middle of the tower of St. Clement's. The street, so arranged, would have an irregular, haphazard effect, entirely wanting in the regular dignity and beauty proper to so great a scheme as the alteration of the most important thoroughfare in the capital of the Empire.

Admitting that Mr. Hamo Thornycroft's fine scheme is too costly to be entertained. I would point out that three other proposals have been before the Council which more or less avoid these mistakes, and that the one proposed by the Royal Institute of Architects and that suggested by Mr. Riley, the architect of the Board, do not involve a ruinous sacrifice of ground value, considering the importance of the occasion. I trust it may not be too late to urge the reversal of a decision so unworthy of a great opportunity.

Another serious danger which threatens the architectural effect, if we may judge by what has been begun, is the enormous scale of the buildings that seem to be contemplated. The scale proper to the street is given by Somerset House and the two churches, which rank among the most valuable architectural ornaments of London, and have always, till lately, dominated every view of the Strand, and should continue to do so. But the improvements committee of the Council promise us "an imposing effect for the

buildings to be erected on the northern side of the Strand," from which we may anticipate a continuation of the enormous pile next the new Gaiety Theatre, which will reduce the churches to insignificance. From this disaster, I hope some expression of public opinion will save us. There is plenty of room for "imposing effects" in Kingsway and Aldwych, where there will be no old buildings to spoil. We do not want them in the Strand. The County Council owns the site, and can make any rule they please as to scale. A reduction in height would no doubt mean some pecuniary sacrifice, but I venture to think that in no other capital of Europe would that be allowed to prevent so grand a scheme from being carried out in the best way for architectural effect. If purely commercial considerations are always to prevail when the question between an artistic and an inartistic way of doing things touches our pockets, surely the elaborate system of art teaching we so diligently promote throughout the country may be suspected of insincerity and of being little more than an expensive imposture.

T. G. JACKSON.

OBITUARY.

SIR ISAAC LOWTHIAN BELL, BART., LL.D., F.R.S.—Sir Lowthian Bell, who died at his residence, Rounton Grange, Northallerton, on the 20th inst., had been a member of the Society of Arts since 1859. He was elected on the Council in 1876, and in 1895 he was awarded the Albert Medal of the Society "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches, and the resulting development of the iron and steel industries." He was born on February 15, 1816, at Newcastle, his father being an ironmaster, Mr. Thomas Bell, and his mother, a daughter of Mr. Isaac Lowthian, of Newbiggin, in Cumberland. After attending Edinburgh University and the Sorbonne, Paris, he spent some time in travel on the Continent, and then, at the age of twenty-four, entered the Walker Ironworks, near Newcastle, in which his father was a partner. There he remained till 1850, when he became connected with chemical works at Washington, in North Durham. Under his direction, these became one of the most important concerns of their kind in the North of England. He greatly enlarged them, and laid down extensive plant for the manufacture of an oxychloride of lead introduced as a substitute for white lead by his father-in-law, Mr. H. L. Pattinson, F.R.S., with whom he was associated in the business at Washington. There, too, was introduced in 1860 almost the first plant in England for the manufacture of aluminium by the Deville sodium process. Soon after the discovery of the main bed of Cleveland ironstone near Middlesbrough by John Vaughan, in 1850, in conjunction with his brothers Thomas and John, he started iron works at Port Clarence, on the north bank of the Tees. In the development of the Cleveland iron industry his firm played a very important part, and what has been the extent of that development may be judged from the fact that whereas the district in 1850 produced less than 25,000 tons of pig iron, at the present time Middlesborough accounts for about one quarter of the total output of this country. The establishment of a chemical laboratory in connection with the Clarence works shows how fully Bell realised the importance of the scientific study of industrial processes, and his own researches on the chemistry of iron and steel, some of which have been translated into French and German, have become classic. Many of the most important of these appeared first in the form of papers read before the Iron and Steel Institute, and a number of them were subsequently collected and published in a thick volume entitled "The Chemical Phenomena of Iron Smelting." Sir Lowthian was also the author of a book on the "Principles of Iron and Steel Manufacture," as well as of many papers contributed to other scientific societies. He was one of the original founders of the Iron and Steel Institute in 1869, he filled the office of president from 1873 to 1875, and in 1874 he became the first recipient of the gold medal instituted by Sir Henry Bessemer the year before. He was a past president of the Institution of Mechanical Engineers.

ADMIRAL SIR ERASMUS OMMANNEY, K.C.B., F.R.S.—Sir Erasmus Ommanney, who died at Southsea, on Wednesday, 21st inst., had been closely connected with the Society of Arts for many years. He was elected a member in 1864, joined the Council in 1870, and was a vice-president from 1874 to 1887. He was a frequent attendant at the evening meetings, and the original Chairman of the African Section, which was founded in 1874. He was born in 1814, and was the seventh son of Sir Francis Molyneux Ommanney, for many years M.P. for Barnstaple, and well-known as a Naval agent. He entered the Navy in August, 1826, under the care of his uncle, John Ackworth Ommanney, then captain of the 74-gun ship *Albion*, which in December convoyed to Lisbon the troops sent out for the defence of Portugal against the Spanish invasion. From Lisbon the *Albion* joined the Mediterranean fleet, under the command of Sir Edward Codrington, and took an effective part in the battle of Navarino, on October 20, 1827. Having passed his examination in 1833, he was promoted on December 10, 1835, to be lieutenant, and a few days later was appointed to the *Cove*, a small frigate under the command of Captain (afterwards Sir) James Clarke-Ross about to proceed to Baffin's Bay for the relief of a number of whalers reported to be caught in the ice. The objects of the expedition were successfully carried out, notwithstanding the extreme danger of the navigation during the winter months. Lieut. Ommanney was then for three years flag-lieutenant to his uncle, Sir

J. A. Ommanney, on the Lisbon station and in the Mediterranean; and on October 9, 1840, he was promoted to be commander. For three years he commanded the *Vesuvius* steamer in the Mediterranean. On November 9, 1846, he was promoted to the rank of captain, and during the years 1847-48 he was employed under the Government Commission in Ireland, carrying into effect the relief measures and the new Poor Law. In 1850-51 he commanded the *Assistance* in the Arctic search expedition, under Captain Horatio Austin, and was the actual discoverer on August 25, 1850, of the first traces of Sir John Franklin, which, on a fuller examination, proved that his ships had wintered at Beechey Island. He also directed an extensive system of sledge journeys, by which the coast of Prince of Wales Land was laid down. On his return from the Arctic he was appointed Deputy Controller of the Coastguard, and on the outbreak of the Russian war was sent to the White Sea in command of a small squadron which, during the summer of 1854, blockaded Archangel, prevented all coasting trade, and destroyed large quantities of Government property. In 1855 he was captain of the *Hawke*, a ship of 60 guns, in the Baltic, and was employed for the greater part of the time as senior officer in the Gulf of Riga, where a rigid blockade was kept up. In 1857 he commanded the 80-gun ship *Brunswick* in the West Indies. He obtained flag rank on November 12, 1864, and on March 13, 1867, was made a C.B. He became a Vice-Admiral on July 14, 1871, and an Admiral, on the retired list, on August 1, 1877. A few days later, August 13, he was knighted. He had the medal for Navarino and the Baltic; in 1890 he received from the King of Greece the Cross of Grand Commander of the Order of the Saviour; and on June 26, 1902, the intended date of King Edward's Coronation, he was nominated a K.C.B.

GENERAL NOTES.

INDIAN TECHNICAL SCHOLARSHIPS FOR TEXTILE STUDY.—The Bombay Local Government has recently invited applications from candidates for two scholarships tenable for a period of two years. The recipients are to proceed to England to undergo a special course of study in subjects connected with the textile industry. Each scholarship is of the value of £150 a year, and in addition a second-class passage to and from England, together with the fees charged for special courses of study, will be paid by the Government. One scholarship is to be assigned for a special course of study in accordance with the textile syllabus of recognised English institutions. The recipient of the other scholarship is to undergo a thorough course of chemistry in its application to textile requirements, and especially to textile fabrics. Applications are receivable from those, who, in addition to having been engaged in practical textile work for at least two years, have also passed through the full textile course of the Victoria Technical Institute, or have obtained the B.Sc. degree at the Bombay University. The Government reserves the right to extend these scholarships for a third year in the event of good progress having been shown by those holding them.

AMERICAN IRON AND STEEL PRODUCTION IN 1903.—According to the statistics collected by Mr. James M. Swank, the general manager of the Iron and Steel Association, there was only a slight decline in activity during 1903. The consumption of pig iron fell from 18,436,700 tons in 1902 to 18,039,909 tons. There was a slight increase in the production of open hearth steel, the output being 5,829,911 tons in 1903, as against 5,687,729 tons in 1902. On the other hand, the output of Bessemer ingots was only 8,592,829, as against 9,138,363 tons in 1902. Pennsylvania has been the chief centre of the steel industry, having produced 1,186,284 tons of steel rails, as against 1,760,472 tons manufactured by all the other States of the Union. Out of a total American output of 1,095,813 tons of structural steel, Pennsylvania produced 1,004,375 tons, or 91 per cent.

IRISH FARM PRODUCE.—In referring to the milk question in the last issue of the *Journal*, it was said that even in Ireland efforts were being made to improve farm management. That much remains to be done in this direction is suggested by the Report of the Irish Agricultural Organisation Society for the eighteen months ended June last. Referring to butter, the Report says that a fruitful source of bad quality is to be found in the carelessness displayed by milk suppliers in cleansing the churns. "These cannot be properly cleansed after each delivery except by a thorough scouring, and this, it is certain, they frequently do not get. To overcome this difficulty, societies are advised to procure and supply, on easy terms of payment, proper steel churns. A case came under the notice of the Irish Agricultural Organisation Society quite recently where milk was supplied in bad condition, and when butter made therefrom had to be sold at 14s. per cwt. under the current market price." As to the treatment of cows, the report says "The feeding and general treatment of dairy cows, in the southern counties especially, is little better than that which is meted out to cattle in Siberia. It is cruel, wasteful, and stupid. Starved cows cannot produce good calves; nor can they put fat in the pail while they are vainly engaged in trying to put it on their sorry carcases." As for Irish butter, the trade are told that more attention must be paid to cleanliness, attractiveness in appearance, and general business details." Still, there is improvement, and refrigeration has done much. "As a result of the installation of cooling machinery and the general use of ice, complaints as to want of 'body' are growing fewer and fewer, and in no single case has a co-operative

creamery, so equipped, had any difficulty in keeping within the limit of 16 per cent. of water imposed by law. And there can be no question whatever that the improved produce and the enhanced value, together with the absence of claims for short weight, have more than justified the enterprise of those societies which have made this addition to their equipment."

ALIEN IMMIGRATION.—So much is being said just now about the increase in alien immigation, that it may be useful to quote the official figures as given for last month and the eleven months ended November 30, 1904, comparing them with the corresponding period of last year. The total number of aliens landed in the United Kingdom in November, 1904, numbered 18,325, as against 13,433 in the corresponding month of 1903, but of these 7,824 and 6,449 respectively were *en route* to places out of the United Kingdom. Thus the aliens who arrived to remain in November of this year numbered 10 499, as against 6,684 in 1903, and of these 1,158 and 1,130 respectively were sailors. If the eleven months ended November 30, 1904, are taken, the total number of aliens landed on our shores in 1904 was 180,598, compared with 198,259 in 1903, but of these no fewer than 121,452 were *en route* in 1903, and 94,627 in 1904. The number of aliens not described in the alien lists as *en route* to places out of the kingdom was 85,971, as compared with 76,807 in 1903, or an increase of a trifle under 12 per cent. But as the return points out, it must not be assumed that the whole of the 85,971 come to this country for settlement, "there being, in fact, a large emigration of foreigners from this country, while many of the aliens arriving from Continental ports return to the Continent." Taking the November returns, by far the larger number of aliens, rot *en route*, landed at London—6,147 out of a total of 10,499—but of those *en route*, none came to London, the vast majority going to Grimsby and Hull. It is noticeable that of the aliens landing to stay, more come *via* Hamburg, Bremen, and Bremerhaven, than by any other route, next from Rotterdam, Amsterdam, and Antwerp, and then from Libau. Of the 1,309 Russians arriving here from Libau last month, only 235 were *en route*, whereas of the 905 coming from Finnish ports only 113 were not *en route*.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

JANUARY 18.—"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES. SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., will preside.

JANUARY 25.—"London Electric Railways." By the HON. ROBERT P. PORTER.

FEBRUARY 1.—"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

FEBRUARY 8.—"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY.

FEBRUARY 15—

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN.

Dates to be hereafter announced :—

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTON.

"Application of Electricity to the Location of Mineral Deposits." By ALFRED WILLIAMS.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

JANUARY 19.—"The Highlands of Sikkim." By DOUGLAS W. FRESHFIELD. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

APRIL 6.—

MAY 11.—"The Manufactures of Greater Britain.—III. India." By HENRY JOHN TOZER, M.A.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock :—

JANUARY 24.—"British Commercial Prospects in the Far East." By BYRON BRENAN, C.M.G., late H.B.M. Consul-General at Shanghai.

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

MARCH 28.—The Manufactures of Greater Britain.—II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILY HEWITT. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials." By MARION H. SPIELMANN. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR LALIQUE (Paris).

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic, and Fountain Pens." Three Lectures.

LECTURE I.—JANUARY 20.—*Ancient Writing Implements.*—The Stylus and Tabula—Calamus or reed pen—Stencil—Quills, quill nibs, attempts to make quills more serviceable—Substitutes for quills—Silver pens—Ink horn and penner—Ancient writing outfit—Eastern writing implements—Survival of ink horn—Japanese writing box and pens—Their portable writing set—Early metal pens—Steel pens—Barrel pens—First patent for metallic pens—Improvements in steel pens with the object of increasing their ink-holding capacity — Reservoir nibs, various illustrations.

LECTURE II.—JANUARY 27.—*Stylographic Pens.*—Rudimentary forms—Early patents—Rigid points, needle points—Various writing or marking pens—Modern Stylographic pens, Nota Bene, Cygnet, and others—Gold pens, description of manufacture.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements — Self-filling reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HERBERT LAWS WEBB, "Telephony." Four Lectures.

March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

JUVENILE LECTURES.

Wednesday afternoons, January 4 and 11, 1905, at Five o'clock, CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Two Lectures.)

LECTURE I.—JANUARY 4.—A short history of the early days of illustrated newspapers—Preparations for illustrating events - How sketches are made—Special war artists—Photography on the battlefield—The amateur photographer—Drawing from sketches Siege sketches by balloon post—Mafeking sketches by Colonel Baden-Powell—Production of process plate.

LECTURE II.—JANUARY 11. — Compositors at work—Preparation of stereos—Manufacture of paper—The printing office—Folding and stitching machines—Colour printing—Importance of good titles—The editor's waste-paper basket—Curious sketches: the Russian censor—Foreign illustrated newspapers.

The lectures will be fully illustrated by lantern slides. An exhibition of drawings will be shown on the walls.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 2...Victoria Institute, 8 Adelphi-terrace, W.C., 4½ p.m. Rev. Arthur Elwin, "Confucianism."

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Mr. Eric S. Bruce, "Balloons."

TUESDAY, JAN. 3...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Mr H. H. Cunynghame, "Ancient and Modern Methods of Measuring Time." (Lecture IV.)

WEDNESDAY, JAN. 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lectures.) Mr. Carmichael Thomas, "The Production of an Illustrated Newspaper." (Lecture I.)

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Mr. Eric S. Bruce, "Airships."

THURSDAY, JAN. 5...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Mr. H. H. Cunynghame, "Ancient and Modern Methods of Measuring Time." (Lecture V.)

FRIDAY, JAN. 6...London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Mr. Eric S. Bruce, "Kites and Flying Machines."

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. Alfred Cox, "Libraries."

Geologists' Association, University College, W.C., 8 p.m. Dr. C. Gilbert Cullis, "The Third Issue of the British Association Geological Photographs." (Illustrated by lantern slides.)

SATURDAY, JAN. 7...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lectures.) Mr. H. H. Cunynghame, "Ancient and Modern Methods of Measuring Time." (Lecture VI.)

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FRIDAY, JANUARY 6, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 11, 5 p.m. (Juvenile Lectures.) CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Lecture II.)

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

On Wednesday afternoon, January 4th, Mr. CARMICHAEL THOMAS delivered the first lecture of his course, addressed to a juvenile audience, on "The Production of an Illustrated Newspaper."

Mr. Thomas introduced the subject of his lectures, the past history of which is hardly less fascinating than its modern development, by a summary of the earliest attempts which were made to accompany the paragraphs of news in the old news-sheets or tracts by rough drawings. The first attempt of this kind was published in 1607, and the quaint woodcut was entitled "Wofull News from Wales, or the lamentable loss of divers Villages and Parishes (by a strange and wonderful Flood) within the County of Monmouth in Wales, which happened in January last, 1607, whereby a number of his Majesties subjects inhabiting in these parts are utterly undone." The realistic picture of this occurrence was followed by another of an even more tragic kind, which was also taken from an early seventeenth century tract. The title of the picture, which appeared to need considerable explanation, was lengthy, and ran: — "News from Penrin (Penrhyn) in Cornwall of a most bloody and unexampled Murther, very lately committed by a Father on his own sonne (who was lately returned from the Indyes) at the instigation of a merciless stepmother, together with their most wretched endes, being all performed in the month of September last, anno 1618." The son, according to the additional details furnished by the letterpress, had returned to his father's house without saying who he was, and had been murdered in the night for the sake of his money. His grasping relatives did no long survive him, for remorse drove them to suicide. It was such incidents as these, which formed the staple attractions of the news-sheets of the time.

A new development arose with the appearance of the first regularly published illustrated paper, the *Mercurius Civicus*, which introduced portraits, including one of Charles I. and his Queen, and another of the Lord Mayor of 1643, Isaac Pennington. It was the *Mercurius Civicus* which introduced the bad precedent of publishing as an authentic representation of the man of the moment, any convenient portrait which happened to be at hand. The *Mercurius Civicus* was founded in 1643, and the illustrated newspaper might be said to have become firmly established in 1650, and to have made steady progress during the next century. In the eighteenth century, it sometimes utilised distinguished artists as illustrators. The heading of the *Jacobite Journal* which Mr. Thomas threw on the screen was, for example, attributed to Hogarth; and towards the end of the century, the *Observer* began occasionally to introduce pictures of current scenes, and events of popular interest. A very interesting one was that of Mr. Gurney's new steam carriage, the prehistoric motor car as it might be called, which was exhibited in Regent's-park. The staid *Times* followed suit on great occasions, and the day after Nelson's funeral, in 1806, published a very good view of the funeral car. Most interesting

also were the illustrations of the Cato-street Conspiracy which the *Observer* published, and which included up-to-date representations of the exterior of the Cato-street house, and the interior of the bomb itself. With the rise of the *Illustrated London News*, the first paper in which the drawings were the predominant feature, illustrated journalism took an entirely new position. The paper was founded by Herbert Ingram, and, still conducted by an Ingram, its editorship has remained in the family for three generations. Much of its earlier success was due to the drawings of Mr. (afterwards Sir) John Gilbert, a fine drawing from whose pencil, the opening of Parliament by Queen Victoria in 1846, was shown on the screen. The *Illustrated London News* was followed by *The Graphic*, founded in 1869 by Mr. W. L. Thomas, and this in its turn was followed by the *Daily Graphic*, whose initiative in publishing every day pictures of the previous day's occurrences, was constantly finding fresh imitators among the daily newspapers of all countries.

Having sketched the rise and progress of the newspaper which published illustrations, Mr. Thomas went on to describe, with many illustrations of drawings actually made and afterwards reproduced, the work of the artist and the artist-correspondent in gleaning his material and despatching it to the office of the paper where it would be reproduced, either in the form in which it was received, or developed so as to make it suitable for reproduction. One drawing shown was that of a Macedonian insurgent hurling a bomb, a subject which by its nature did not invite the artist who made it to linger longer in the neighbourhood than was sufficient for a very rough sketch; another was that of the act which won for Captain Smyth the V.C. at the battle of Khartoum in 1898. The first of these sketches was "redrawn" in a London studio; the second was "finished" by the artist, Mr. W. Maud, at the seat of war. The camera and the photographer sometimes took the place of the artist and his pencil, and each had their diverse uses and advantages. A snapshot of General Kuropatkin and his staff watching the battle of Liao-yang was rightly and effectively the complement of a drawing made by the artist (Mr. Whiting) of the general aspect of the battle. Each picture had its special interest from the other. Similarly two other snapshots, one of which showed the balloon accident that befell the aeronaut M. Severo, and the other the sinking of H.M.S. *Victoria* by the *Camperdown* in 1893, had a tragic and realistic interest which no drawing, however artistic, would possess. There were other examples in which by its ability to produce an effect of realism, or of irrefutable occurrence, the camera had the advantage over the artist, just as there were many instances where the artist by correcting the confused, or indistinct, or insufficient impressions of the camera could convert an uninteresting photograph into a true and lively picture of what actually occurred.

From the making of sketches and photographs, Mr. Thomas turned to their despatch. He described the sending of drawings from Paris (many of the originals of which lined the walls of the meeting-room) during the siege. They were sent by balloons, some of which were brought down by rockets or projectiles as they floated across the German lines, some were followed and captured by light cavalry, and one actually drifted to Norway. These sketches, despatched with such zeal and under circumstances of such difficulty, conveyed an impression of Paris during the horrors of the siege that was unsurpassable in its realism. There were, however, many difficulties encountered since then, which if overcome in a less ingenious way, called for no less energy and determination, and there were the drawings sent out from Mafeking by General (then Colonel) Baden-Powell, which were brought south by runner and eventually found their way to the *Graphic*. One of these showed the boys of the Cadet Corps which Lord Edward Cecil organised during the siege; another the children playing "Siege Games"; another the men in the trenches throwing bombs by means of sticks; and yet another the Mafeking trenches just at the time when the seventieth shell was bursting after a long day's attack. "So little damage," said the accompanying letterpress, "was done that the Boers became quite disgusted after firing 1,500 94-pounder shells and withdrew the guns altogether." In another part of Africa, during the last Soudan compaign, the *Graphic* artist sent his letters and telegrams down the Nile by native swimmers. These amateur postmen floated sixty miles down stream on logs and delivered their post with faithful regularity. The difficulties were hardly less great, and the methods of surmounting them hardly less ingenious in the present war in Manchuria, where, as the *Graphic* artist has pictorially shown, warnings are posted up everywhere to forbid sketching or photographing without permission.

Finally, after describing the postal methods and facilities in England, Mr. Thomas described the first steps which were taken to deal with the drawing when it reached the office in order to fit it for reproduction and printing. It was first of all photographed through a screen. The screen consisted of two sheets of glass on which finely ruled parallel lines were drawn, and these were fastened together so that the lines, at right angles to one another, made a network of tiny squares. The drawing, correctly focussed through the lined screen, was impressed on the negative behind it, and its image was thus broken up, as it were, by the meshes of the screen into arrangements of stippled dots, close together where the drawing was dark, and far apart where the drawing was light. Next, a piece of polished copper was coated with sensitized glue which, when exposed to light, became hardened. This was pressed in contact with the negative, and was exposed to strong light. The parts which had not been exposed to the light washed off on development in warm water. In other words, the light parts being soft, were washed away, and the dark remained. The plate then had dark and light assemblages of dots corresponding to those of the photographic negative. When the plate thus covered with dots had been made, it was then put into an acid bath, which bit away the spaces between the dots, leaving them in high relief. If the plate were now inked, the tops of the dots would be quite black while the lower surface were white; and that was the whole secret of turning a drawing into a plate from which prints could be made.

The second lecture will be delivered on Wednesday next, the 11th inst., at 5 p.m.

INDIAN SECTION.

Thursday afternoon, December 8th. Sir Charles H. T. Crosthwaite, K.C.S.I., Member of Council for India, in the chair.

The Chairman deplored the event which had caused him to be asked to take the Chair that afternoon. They all must regret the sudden death of Lord Hardwicke, a man of great promise and courage, who, if he had lived, would have taken a high place among the public men of the country. The Chairman then introduced Sir Frederic Fryer. When, in 1887, he (the Chairman) went to Burma as Chief Commissioner, Sir Frederic was Commissioner of one of the largest divisions in the upper province, to which he had come from the Punjab with the reputation of an active and able frontier officer. He maintained and increased his reputation all the time he was in Burma, and after he (the Chairman) had left, Sir Frederic became Chief Commissioner and eventually Lieutenant-Governor. He came before them that afternoon with 17 years' experience of Burma.

The paper read was—

BURMA.

By Sir Frederic Fryer, K.C.S.I.

Physical Features.

The province of Burma stretches along the whole sea-line of the eastern side of the Bay of Bengal. It is bounded on the east and north-east by China; on the north-west by Bengal, Assam, and the Manipur State; on the west and south by the sea; to the south-east lies the kingdom of Siam. The total area, including the Shan States, Chin Hills, and Karenni, has been estimated at 238,738 square miles. The area of Burma proper is about 168,573 square miles, of the Chin Hills some 10,250 square miles, and of the Shan States, which comprise the whole of the eastern portion of the province, some 59,965 square miles. The extreme length of the province is 1,200 miles, and its extreme width is 575 miles. The population is 10,489,024, according to the last census.

Burma is watered by five great rivers, of which the principal is the Irawadi, known to the Burmans as the Ayawadi or Father of Waters. Burma is encircled on three sides by a wall of mountains—the Arakan Hills, the Chin Hills, the Kachin, Shan, and Karen Hills. The most fertile tract in Burma is the Irawadi delta, a flat, alluvial plain, of a most uninteresting character, 12,000 square miles in area, where vast crops of paddy are grown.

The People of Burma: their Religion and Customs.

The people are described by Sir Arthur Phayre, in his "History of Burma," as a union of Mongoloid tribes, who have been considerably influenced by immigrations of Aryans. The Burmans, however, still maintain their distinct nationality. Their language and dress are peculiar to themselves. So also are their laws. They follow the Buddhist religion, and in appearance and physique are quite dissimilar to the Aryans. Though

the Burmans are Buddhists, they have a great respect for spirits, and were, no doubt, Animists before they were converted to the religion of Buddha. In every village shrine are found local "Nats" or spirits. Some "Nats" are evil and some good. In either case it is well to keep on good terms with them, and whether good or bad they have to be propitiated. Burmans, too, have a thorough belief in charms. They believe that a man may be made proof from bullet, sword, or drowning.

I remember finding a man in jail, who had been sentenced to a long term of imprisonment for killing another man. He told me that he had cut off a man's arm, and the man had bled to death. He explained that the man said he had a charm against sword cuts, and had challenged him to cut him with a sword. He accordingly did so, and was much surprised at the result, as he had no idea that the sword would injure the man. The story told me was, I found, quite true, and I remitted the man's sentence. In another case, which came to my notice, a Burman who had what he thought a charm against drowning, asked to have his arms and legs tied, and then got his friends to throw him out of a boat into the river. The natural result was that he was drowned.

There is no caste among Burmans, and they mix freely with those of other religions. They are exceedingly hospitable, and in all but the very smallest jungle villages there is a guest-house, where any stranger can rest himself and be supplied with food by the villagers.

There is no such thing as seclusion of women, and women mix freely in society. They are consulted in all matters of importance, and most of the petty trade of Burma is carried on by women. When a Burman visits an English officer he is generally accompanied by his wife, and often brings his daughters too, if he has any.

Education is very general amongst Burmans, as in every village there is an elementary school kept by the monk or monks, who teach the boys of the village. It is very rare to find a Burman who cannot at least read and write.

Burmans are naturally kind. They are very fond of children. They also treat their animals well. Burman ponies and cattle are always in good condition. Burmans never milk their cows, as they think it wrong to deprive calves of their natural sustenance. It is only when Burmans are excited that they become cruel. They are all fatalists, and face death with equanimity. It might be thought that they would make good soldiers, but in this they fail, owing to their want of any habits of discipline. The Burman has often been tried as a soldier, but the result has always been failure.

Burmans are cheerful, gay and laughter-loving. They are fond of gay colours, and the women, dressed in bright colours, with flowers in their hair, are very attractive. They are very fond of theatrical performances, which are often very long. The principal roles are those of Prince and Princess, and there is always a clown or two. Shouts of laughter at the clowns' jokes are frequent.

History of Burma.

The advance of the British power in Burma has been very gradual. Our knowledge of the country in the years previous to the first Burmese war is derived from the accounts of travellers, and from the reports of the many officers who from time to time visited Burma in charge of embassies to the King of Burma. In 1695, Messrs. Fleetwood and Sealey visited Ava on a mission from the Governor of Madras, and from that time till the first war was declared against Burma in 1824 there were frequent missions to the court of the King of Burma, to all of which the King behaved in a more or less arrogant manner, generally considering it beneath his dignity to receive the ambassadors sent by governors who were themselves subjects of the kings of England.

The first Burmese war was due to the encroachments of King Hpagyidoa on our borders in Chittagong and to his invasion of Kachar. As a result of this first Burmese war the province of Arakan, the districts of Tavoy and Mergui, and that part of the Tenasserim province which lies to the east of the Salween river, were annexed to the British dominions in February, 1826. The Kubo Valley was also made over to Manipur. The town of Maulmein was then rebuilt and became the headquarters station of the province of Tenasserim, which it still continues to be. In 1830, the Kubo Valley was restored to Burma at the intercession of Colonel Burney, the first Resident at the Court of Ava, an annual payment being guaranteed by the British Government to the Raja of Manipur, as an equivalent for the loss of the valley. Arakan was at that time administered by the Commissioner of Chittagong, under the orders of the Governor-General, as Governor of Bengal, whilst the

Tenasserim province was administered under the direct orders of the Governor-General in the latter capacity.

The second Burmese war was due to the refusal of the then King of Burma to be bound by the Treaty of Yandabo, which terminated the first Burmese war, and as a result of that war the province of Pegu became part of the British dominions, and the whole of Lower Burma up to Prome was lost to the King of Burma. The second Burmese war was determined by the Governor-General's proclamation of the 20th of December, 1852, annexing the province of Pegu. In 1853 the whole of Lower Burma, except the provinces of Martaban and Tenasserim, was placed under one Commissioner, with his headquarters at Rangoon. The province of Martaban consisted of the tract between the Salween and Tsitgoung rivers up to Rouk Pha Wa, west of the Panloung mountains, and was placed under the Commissioner of Tenasserim. In 1862, the whole of Lower Burma was united into one province, under a Chief Commissioner, Sir Arthur Phayre. It was not till 1885 that, owing to disputes with King Thebaw, war was for the third time declared with Burma, with the result that the King was deported to India, and in 1886 the remaining territories of the King of Burma were annexed to Great Britain. From 1886 to 1897 the whole of Burma was administered by the Chief Commissioner. On the 1st of May, 1897, the province was raised to a Lieutenant-Governorship, and a Legislative Council for the purpose of making laws and regulations was constituted. The number of members of council is nine, of whom four are ordinarily non-officials, and the Lieutenant-Governor is President of the Council. The Members of Council are nominated by the Lieutenant-Governor.

Pacification of Upper Burma.

The state of things now prevailing in Burma is very different from what it was when I first went to Burma in August, 1886, as a commissioner in Upper Burma.

At that time it may safely be said that armed opposition to our rule prevailed throughout Upper Burma, except in the capital, Mandalay, and in those parts of the country which were dominated by our troops. This was a result in great part of the anarchy which had prevailed in the last years of Burman rule, and also, in a measure, of the number of armed men who had dispersed over the country after its occupation. In King Thebaw's time it had been usual for each local governor to countenance the existence in the tracts of country ruled over by him of bands of armed marauders, whose misdeeds he overlooked on the simple condition that they confined their depredations to the jurisdictions of other governors than those under whose protection they lived. These marauders preyed on their own countrymen, and though, after annexation, they waged a guerilla war against the British, still they never ceased to plunder and murder their fellow subjects, and can in no way be regarded as patriots.

It was only by putting out a large number of military and police posts, by establishing roads, and maintaining constant communication by patrols between the different posts, by clearing away the dense jungle in which these men found a refuge, and by persistently disarming the villagers, that any head could be made against the disturbers of the peace. Very much was gained from the mutual dissensions of the so-called dacoit leaders, but the measure to which the rapid pacification of Upper Burma may principally be attributed was the Upper Burma Village Regulation, No. XIV., of 1887. The object of this measure was to restore and enforce the system of village responsibility which had formerly existed in Burma, but which had long fallen into disuse.

This Regulation very greatly strengthened the hands of district officers, and villagers found that they could no longer harbour and abet dacoits with impunity.

Before the Regulation was passed, it was a village saying that the sword of the dacoit was sharp, whilst that of the Government was blunt, that is to say, that any information given to the Government regarding the dacoits was generally followed by sharp and stern retribution, whilst villagers, who kept in with the dacoits, had little to fear from the Government. When the country people knew that the Government could, and would, protect them, whilst any collusion with dacoits would be punished, they began to find it to their interest to side with the supporters of the law, and with the aid of the people thus secured there was little difficulty in clearing the country of its oppressors, more especially as pardon was freely given to all dacoits who had not been guilty of heinous crimes on condition of surrendering their arms and living peaceably in future.

To facilitate the carrying out of the Village Regulation, all villages were required to stock-

ade themselves, and the residents of villages not in a position to defend themselves were required to move temporarily into the larger and stronger villages.

So rapidly did the pacification of Upper Burma proceed owing to these measures, and to the ample force of military and police placed in the field to support them, that at the close of the first five years of our administration of Upper Burma violent crime in the upper province was less than in the lower province.

In dealing with Burma, it must be remembered that the national crime of Burma is gang robbery with violence, and that no Burman is thought any the worse of by his countrymen because he is a dacoit. Burmans are an excitable race, and fond of anything which relieves the ordinary monotony of life. The nature of the country, too, with its dense jungles, lends itself readily to a robber's life. Burmans do not adhere to the tenets of their religion, which is most tenacious of the sanctity of life. If violent crime is still too rife in Burma there is little other crime, and though dacoity is certainly not a desirable form of crime, still, if some allowance be made for national idiosyncracies, we should not wonder so much at the difficulty experienced by British officers in Burma in repressing a crime which is no more looked upon with horror by the Burman than some forms of murder are by the Biloch, and most forms of murder by the Pathan.

Frontier Questions in Burma.

When the pacification of Burma had been accomplished the Government turned its attention to frontier questions.

We found the Shan States in a state of anarchy. Six of the rulers had rebelled against the authority of King Thebaw. We began the work of subduing the Shan States in 1887, and all the chiefs had submitted by the end of 1888. We entered the Chin Hills in 1888, but it was not until 1896 that the Chins were effectually disarmed, and even then they managed to obtain fresh arms, and the disarmament had to be carried out again in 1898.

The Kachins of the Bhamo and Myitkyina district were a great deal more difficult to deal with, and 1903 was the first year in which they gave no trouble. The Shan States, the Chin Hills, and the Kachin Hills are each administered under their own regulations. The Shan States are divided into the Northern and Southern States, each under a separate superintendent.

The Revenue System.

Having now told you something of Burma in general, I will proceed to give a short sketch of the revenue system of Burma, which differs much from what we have been accustomed to in India.

When I first went to Burma the unit of the revenue system was in Lower Burma the circle, and in Upper Burma the village. Each circle or village had a headman or Thugyi. In Lower Burma groups of villages had been united into circles, and the original idea of a village headman had been lost sight of. The Thugyi or headman was a revenue collector and little else. Now as Thugyis in Lower Burma have died out or retired, the village headman has been restored, and the circle headman is rapidly disappearing. The village will now, therefore, be the unit throughout Burma. The restoration of the village system, under responsible village headman, was one of the reforms inaugurated by Sir Charles Crosthwaite.

In Burmese times, in Lower Burma a rough calculation was made of the cultivated land in each village, and a rate per acre was levied on the area supposed to be cultivated. Besides this, one-tenth of the produce of each plough was taken in kind, and there were all sorts of other taxes, such as import and transit duties, monopolies, and forced contributions from time to time. In 1798, for instance, the king levied a forced contribution of six lakhs of rupees, and this operation was repeated whenever the royal exchequer needed replenishing.

In Upper Burma, before annexation, the main source of revenue was a tax called Thathameda, from a Sanskrit word signifying one-tenth. Each household was required to pay one-tenth part of its estimated annual income to the Crown. The whole village was held jointly responsible for the payment of this tenth, which was assessed according to the number of households. The amount to be paid by each village was settled according to the means of each household by a village council selected by the community and called Thamadis. No revenue was levied from private lands, but from State lands, which consisted of the King's private property, constantly added to by confiscations of the property of State offenders and by royal marriages, revenue was levied in kind, or by a commutation of pay-

ments in kind for payments in cash. Parts of the State domains were assigned to members of the Royal Family and to high officials, generally for life, and they were allowed to make what they could out of them. The tenants of State lands had no permanency of tenure and were constantly liable to be ejected in favour of other tenants offering higher rents or when the estate changed hands. The royal domains included all islands in the river and all forests and uncultivated lands.

In Lower Burma, when Arakan was annexed, the villages were first farmed out to the Thugyi, but in 1828 the revenue was fixed summarily for each village, and the Thugyi were allowed 10 per cent. commission on the revenue for the trouble of collecting it. The Thugyis still receive commission on their collections all over Burma, calculated at a rate which varies according to the amount collected, but not exceeding 10 per cent.

In the Tenasserim province, an average account of the produce of each village was taken at annexation, and a revenue was fixed by assuming 1-5th of the produce to be the Government share. Besides this there was a capitation tax of Rs. 5 on married men and Rs. 2·8 on bachelors, which is still levied throughout Lower Burma, except in certain towns where a land rate has been imposed in lieu of capitation tax. In 1842, these different systems were done away with, and revenue commenced to be levied by fixed rates according to the description of cultivated land. These rates are the only thing fixed about the land revenue in Lower Burma, and for the purpose of bringing new cultivation under assessment and remitting assessment on lands which have fallen out of cultivation, annual surveys are made in all districts which have been regularly settled by the Supplementary Survey Department, which is under the Director of Land Records. Any person wishing to retain his land, although he has thrown it out of cultivation, can do so for five years by paying a fallow rate. In districts, now very few, which have not come under settlement, the supplementary survey work is supposed to be done by the Thugyis. If any man desires to reclaim waste lands he can apply for a period of exemption from assessment, and this is granted according to the nature of the land to be cleared and the labour likely to be required, to clear it.

In Upper Burma the Thathameda system has undergone several variations. It has been decided to assess all private lands. The rate of assessment is to be three-fourths of that on State lands. The rates are fixed either according to the class of soil or to the description of crop grown. Revenue will only be levied on crops which come to maturity in both State and non-State lands. A crop which comes to maturity has been defined as any crop in excess of one-fourth of an average crop. District officers have, however, been authorised to modify this definition to an extent which, while conforming to the general principle, will adapt it to local conditions. The Thathameda, in districts in which it has been decided to assess private lands, has been adjusted on the assumption that the thamadis or assessors will assess those who derive no part of their income from agriculture at full rates—Rs. 10 or more, and the agriculturists at lower rates—Rs. 5 to Rs. 3, to which the average thathameda rate has been reduced or even less.

In certain districts such as Katha, the Ruby Mines, Myitkyina, and Bhamo, it has been decided to abolish the distinction between State and non-State land, on the ground that no such distinction has hitherto been recognised, and that no promise to grant differential rates has been made by the Government.

It has been contended by some authorities that the distinction between State and non-State land is purely artificial, and should never have been recognised. There can, however, be no doubt that it was recognised for several years before annexation, and that when Upper Burma came under British rule land known as non-State was not assessed or was assessed at favourable rates, as compared with State land. Whether the Burmese Government would have maintained the distinction, had it suited them to abolish it, may well be doubted.

The distinction is, of course, very inconvenient, and it necessitates two sets of rates of assessment, and as all waste land is State, any extensions of non-State holdings into waste land are liable to be separately assessed, which will add considerably to the cost of supplementary survey in the upper province.

In the "ya" or dry up-lands of Upper Burma, in which the rates of assessment are very low, the distinction between the two classes of land has been ignored, as to differentiate would be endless trouble, and the extra revenue that might be obtained is not worth consideration. The practical result is that State lands have been assessed at non-State rates.

The changes of system enumerated have been embodied in the Upper Burma Land and Revenue Regulation by an amending Regulation V. of 1901.

In every district it must be decided whether an abatement from the rates fixed on soil or crops shall be made before these rates are applied to the assessment of land other than State. The previous sanction of the Governor-General in Council is necessary to any decision on this point.

The whole of Lower Burma, with the exception of the unsurveyed districts of Salween and the Northern Arakan hill tracts and Tavoy and Mergui and a few other districts, has been regularly settled. Five districts in Upper Burma have been regularly settled, and two are under settlement. The usual term of settlement is 15 years in Lower Burma, and 10 years in Upper Burma, where things are still in a rather fluid state from a revenue point of view.

The total area cropped in Burma in the year 1902-1903 was 11,355,614 acres, and the area occupied but left fallow was 2,892,605 acres. The total land revenue was Rs. 19,832,883.

The peculiarity of the land revenue system of Lower Burma, as distinguishing it from the system in force in Northern India, is that in Lower Burma the rates of assessment alone are fixed, whilst in Northern India the revenue of each village is settled for a term of years. During that term no account is taken of land freshly brought under cultivation, nor is any reduction ordinarily given for land thrown out of cultivation, though in cases of calamity of season, or some exceptional destruction of crops, suspensions or remissions may be given. These cases are, however, not considered at settlement, but are the subject of special rules.

Again, the Lower Burma system differs both from that of India and that of Upper Burma in that there is no joint responsibility of village communities for either the land revenue or the capitation tax in Lower Burma. Each person from whom revenue is due is responsible for the amount at which he is assessed and no more.

Crops Cultivated in Burma.

Rice is the crop to which most attention is paid in Lower Burma. In Lower Burma six-sevenths of the total area under cultivation is devoted to rice. It is sown in June, transplanted in September, and reaped in December or January. The soil of Lower Burma is so rich that no manure is needed except the ashes of the stubble, which is annually burnt. In Upper Burma the rainfall is much less than in the lower province, and much more uncertain, so that rice is generally grown only in irrigated land. Maize, millets, sessamum, gram, wheat, tobacco, cotton, beans, peas, mustard, and indigo, are all grown in Upper Burma. In Lower Burma other crops than rice are little grown, and wheat is not grown at all, and cotton in most districts only to a small extent except in the Thayetmyo district.

In 1902-1903, 1,423,000 tons of rice were exported from Burma between the 1st January and the 30th June, and this export was much below the normal.

Cotton grows in the dry zone, chiefly in the Thayetmyo, Minbu, Meiktila, Myingyan, Sagaing, and Chindwin districts. The soil and climate of the Mandalay district, in which a canal has been constructed by the Government, and of the Shwebo district, in which a canal has been nearly completed by the Government, should be very suitable to the growth of cotton, and this staple might, I think, be introduced in these districts on a large scale. There are steam cotton presses at Allanmyo, in the Thayetmyo district, and at Myingyan. At present, most of the surplus cotton grown in Burma is exported to China. The census returns of 1901 show 136,628 women and girls employed as cotton weavers in Burma, and there are many more who follow cotton weaving as a subsidiary employment. Tobacco, which everybody, man, woman, and child uses in Burma, might be much more extensively grown. At present, the method of curing tobacco is not properly known, and large quantities of the leaf, which might easily be grown in Burma, are imported from India. An attempt was made in the eighties to improve the method of tobacco cultivation in Lower Burma, and an experimental tobacco plantation was started under a Government officer. This attempt was abandoned. Tobacco seed is, however, still distributed, and in the Thingwa district good tobacco is grown from imported seed.

Irrigation in Burma.

It may be said that Burma comprises two wet zones and an intermediate dry zone.

The lower wet zone comprises the greater part of Lower Burma. The districts of Prome, the upper-half of Tharrawaddy, and Thayetmyo, at the north of Lower Burma, have

a smaller rainfall than the rest of Lower Burma.

The lower wet zone enjoys a heavy rainfall, owing to its proximity to the sea. The central dry zone has a scanty and uncertain rainfall, as the excess rain clouds from the lower wet zone vaporise in passage over this zone and discharge themselves in the upper wet zone, which consists of the northern-most districts of Upper Burma.

In the wet zones irrigation is unnecessary, except in the upper districts of the lower wet zone, where irrigation would be most beneficial. The rainfall from the Pegu Hills might be utilised, were it not that the streams from the hills come down in torrents, bringing down large quantities of silt and sand, and are consequently most difficult to control. For this reason, any irrigation projects that have been examined in these districts have been considered not to promise sufficiently good financial results to justify their being undertaken.

In the dry zone proper there are perennial streams or rivers from which canals can be constructed at a moderate expense. The Burmese Government was alive to the utility of canals in this dry zone, and when we took over Upper Burma, we found several canals and irrigation tanks in Upper Burma. There were four canals in the Mandalay district, one in the Shwebo district, thirteen in the Kyaukse district, and two in the Minbu district. There were also a good many tanks. The principal tanks were the Meiktila Lake, the Nyaungyan-Minhla tank, in the Meiktila district, the Kyankse and the Yamethin tanks in the Yamethin district, and the Kanna tank in the Mynigyan district. There were also many minor tanks.

All those works have been repaired and remodelled by us, and we have also constructed the Mandalay Canal, 40 miles in length, which obtains its supply of water from the Madaya River. This canal has 14 distributions. It cost 47½ lakhs of rupees, and will irrigate 200,000 acres. It was opened by me as Lieutenant-Governor in January, 1902. A canal in the Shwebo district, 27½ miles long, with two branches 29 and 20 miles long respectively, is in course of construction. The estimated cost is 48 lakhs of rupees, and it will irrigate 258,658 acres. This canal is three-fourths finished. The Mon canals in the Minbu district, to irrigate 78,575 acres, have been commenced. They are estimated to cost 44 lakhs of rupees.

Besides these works, a good many tanks were constructed in the Yamethin and Meiktila districts, in the scarcity year of 1896. These tanks are not of much use, as in years of good rainfall they are not needed, and in years of scanty rainfall they remain empty. They are of service only in years of moderate rainfall, when they hold up a certain amount of water which is very useful at the end of the rainy season, when the rains cease unusually early. Whilst on this subject, it should be mentioned that two navigation canals, the Pegu-Sittang and the Sittang Kyaikto, were constructed in Lower Burma before 1886. They were intended to obviate the hazards of navigation by sea round the Gulf of Martaban. They are exceedingly useful, and have also drained large areas which would otherwise be water-logged. There is also a navigation canal between the Twanté and Kanaingto creeks 11½ miles long.

Numerous embankments have been made in the delta of the Irawadi River to protect cultivation from floods. These are very remunerative works, and return a considerable interest on the outlay incurred upon them.

The following is a list of the embankments, and of the percentage they return on the capital outlay:—

	Returns.
Irawadi (Kyangin)	1·64
Western (Myanaung)	6·66
Series (Henzada)	41·93
Thongwa Island	17·28

They have brought large areas of land under cultivation. Other embankments are in contemplation.

Communications.

A very important point in the development of a country is that there should be good communications. The splendid waterways of Burma have been taken full advantage of. The Irawadi Flotilla Company have a large and excellent fleet of river steamers. They ply on the Irawadi and Chindwin and Bassein and Tenasserim rivers, and their branches. There is a service of the Arakan Flotilla Company in the Arakan division, which, though on a smaller scale, is very useful. There are very few metalled roads, only 1,678 miles in all Burma. It is true that roads are not so much wanted in Burma as in other countries, as there is good communication by water, by rivers, and creeks in the rains, especially in Lower Burma. There are also 7,903 miles of unmetalled roads. Unmetalled roads are of

little use in the rains, and they are not much wanted in the dry weather when carts can travel across the fields. Bridges over nullahs and water courses are, however, indispensable. Feeder roads leading to the railway are also most necessary. At annexation there were only 327 miles of railway in Burma. Now there are 1,342.

The first line opened was Rangoon to Prome (161 miles) in 1877, and then no progress was made with railways till 1885, when a line 166 miles long was opened to Toungoo. This line was continued to Mandalay (220 miles) and opened in 1889, and was of much help in the pacification of the upper province. It gave employment to the people and opened out what was, perhaps, the most disturbed portion of Upper Burma. Since then the following lines have been added:—

Mu Valley—331 miles—opened at intervals between 1891 and 1899.

Thazi-Myingyan—70 miles—opened to Meiktila in 1895 and to Myingyan in 1899.

This line runs through a country where a great deal of cotton is grown. The earthwork was constructed mostly in 1896, when there was much scarcity in the Meiktila, Myingyan, and Yamethin districts, owing to the failure of the rains, and proved a most excellent method of employing the people.

Sagaing-Alon—70 miles—in 1896. This line avoids a long detour by steamer between Myinmu and Alon on the Chindwin River.

Myohoung to Lashio (177 miles).

This is the Mandalay-Kunlon Railway, of which so much has been heard, and is intended to be carried on some day into China.

This line was a very expensive one and it does not pay anything like its working expenses. It cost Rs. 129,556 per mile, whilst the average cost of railways in Burma calculated, or all the sections taken together, is Rs. 89,000.

Bassein to Henzada and on to Letpadan on the Prome line—115 miles.

Then there are over 32 miles of sidings or minor branches, including 62 miles of double line.

The Rangoon to Prome line pays 10 per cent. on the capital expended on it. The Rangoon to Mandalay line earns from 7 to 8 per cent.

The Mu Valley line does not pay yet, but when the Shwebo Canal is opened, and when there is sufficient rolling stock to work the line properly, it will certainly do so. The branch lines are doing fairly well, and a very great deal is expected from the Bassein-Henzada line.

The Mandalay-Lashio line, will not, I fear, prove remunerative for many years. Two new lines, the Pegu-Moulmein (120 miles) and the Henzada-Kyangin (65 miles) have been sanctioned. There is still a great deal to be done in the way of opening out Burma by rail. There is, of course, the suggestion that Burma should be joined with India by rail which will, no doubt, be carried out some day.

A line to open out the Southern Shan States is very urgently needed, and there are many feeder lines which it would be advantageous to construct.

Then a bridge over the Irawadi river at Sagaing is, in my opinion, greatly to be desired, and the lines to Prome and to Mandalay should be doubled.

FORESTS.

The value of the forests of Burma has long been recognised. The most valuable forest tree is the teak (*Tectona grandis*). It is a mistake to suppose that there are any pure teak forests. The teak tree is found sprinkled either singly or in groups, intermingled with many other kinds of forest trees. There is said to be generally about 10 per cent. only of teak in a forest, and there are, says Dr. Nisbet, lately a conservator of forests in Burma, about 150 different genera and species of forest trees to be found in each several forest. These form an overwood to dense masses of bamboo and undergrowths often 30 ft. to 60 ft. in height, and sometimes shooting up to 100 ft. or more when able to obtain free enjoyment of light. Much damage was done to the forests in which teak occurs by indiscriminate felling in the early days of our administration, particularly in the Tenasserim forests.

The teak tree has always been a royal tree in Burma, and no private person has ever been allowed to fell a teak tree, even though growing on his own land, without a licence. The property of the Government in teak trees being universally admitted, it has been the policy of the Government gradually to reserve all forests in which teak is found in any quantity, and there are now nearly 20,000 acres of reserved forest in Burma. This area is being gradually increased year by year as the Forest Department are able to examine more and more forests. Although the teak tree is a royal tree there are, as I have said, many other trees and much undergrowth in a forest, and in most of the forests the neighbouring villagers

have acquired rights which have to be carefully enquired into. Sometimes, when they are insignificant, they are bought out, but ordinarily they are met by leaving a sufficient portion of the area to meet the wants of the right holders outside the boundaries of the reserve.

The extraction of timber is partly done by contractors, under the immediate control of the Forest Department, and partly by lessees, but no tree may be extracted that has not been girdled by the Government forest officers. Besides the teak there are numerous other trees, which are reserved with the object, principally, of protecting them from destruction. There are about fifteen different reserved trees. One of the most valuable is the cutch tree (*Acacia catechu*), which grows abundantly in the central dry zone. The cutch wood is chipped up and boiled, and yields a rich dark-brown dye.

Then there is the india-rubber tree (*Ficus elastica*). This tree is indigenous in the dense moist sub-tropical forest to the north of Myitkyina, Mogaung, and Indavgyi, and in the upper portion of the area drained by the Chindwin River.

It is collected by Kachins, who sell it to Chinese traders. The produce of india-rubber is rapidly declining owing to indiscriminate tapping, and particularly to the tapping of the roots, which kills the tree.

These india-rubber forests are in the unadministered area, and nothing has yet been done to conserve them. Major Wyllie, when cantonment magistrate of Rangoon, planted a few acres at Kokine, near Rangoon, with india-rubber trees, and his plantation promised very well. Now Government have commenced the planting of 10,000 acres on King's Island, near Mergui, with india-rubber, with a view to show what can be done with inda-rubber in Burma, and in order to induce private persons or syndicates to form further plantations of rubber. There is an experimental garden near Mergui where rubber has been proved to thrive, and for this reason a plantation was formed near Mergui.

The net forest revenue of Burma in 1902-1903 was Rs. 37,74,509. The total export of teak in that year was 229,570 tons, of an average value of Rs. 88,52 per ton.

The Forest Department in Burma is under-handed and might be very considerably increased with great advantage to the administration of the forests, and also, I am persuaded, with much benefit to the forest revenue.

Fire protection is very essential to the conservation of forests. Over 5,000 acres of forests were successfully protected from fire in 1901-1902. Improvement in felling, to encourage the reproduction of teak, and the formation of teak and cutch plantations, are among the important tasks of the Forest Department. The people find employment in these plantations, which gives them an interest in preserving them from fire.

Excise and Opium.

There is nothing peculiar in the administration of the Excise in Burma. Distilleries are owned by private firms, who are required to maintain an Excise officer on their premises. No shop for the sale of liquor or opium can be established without the consent of the inhabitants of the locality.

The use of opium by Burmans is prohibited, except to persons who were above 25 years of age before the 1st of February, 1893, and who registered themselves as habitual consumers. The prohibition of the use of opium by Burmans is, no doubt, a wise measure. The use of opium is contrary to the Buddhist religion, and the drug is very deleterious to Burmans, who are prone to exceed in its use when once they have formed the opium habit. The use of both opium and spirituous liquor was nominally forbidden to Burmans in Upper Burma in the time of the Burman monarchy, and we have continued the prohibition, and done our best to make it effectual. In Lower Burma we do not prevent Burmans from using spirituous liquor, and the consequence is rather anomalous. A Burman may buy spirituous liquors at, say, a refreshment-room on the railway in Lower Burma, but not when the train has passed the boundary into Upper Burma.

Opium is forbidden for Burmans, except to those who hold a certificate allowing them to use it, in both Lower and Upper Burma. The prohibition against the use of intoxicants is very difficult to enforce, especially in the case of opium, which is of small bulk, and is easily concealed. The facilities for smuggling opium are very great. There is a long line of frontier, and the numerous passes and waterways offer great facilities to smugglers. Opium can be and is introduced from China, the Shan States, Siam, and the Kachin Hills, and from adjacent districts in Bengal. The consumption of opium in limited quantities by Chinese and other foreigners, who use it with more moderation than the Burmans, is allowed. The

Chinese say that they cannot maintain their health in malarious climates without taking opium, and they are so habituated to its use that they insist on getting it by foul means if they cannot get it by fair means.

In 1873 rules were introduced by which the right to deal in opium was sold by auction to retail vendors, who were allowed to sell a fixed amount calculated on the number of known opium consumers in the area of each shop. The retail licences were nearly always bought by Chinamen, and there was no doubt that they increased their supply of the drug by smuggling, and that opium was hawked about freely all over the country.

The small number of shops, and their distance from the homes of the consumers, gave a premium to smuggling. It was, therefore, decided that a change in the system of opium administration was needed, and with a view to kill the illicit traffic and to render prohibition effectual, the sale of opium licences by auction was abolished from the 1st of April, 1902, in Lower Burma, and from the 1st of April, 1904, in Upper Burma.

The sale of opium has now been entrusted to selected vendors at a fixed fee, and the sales are made under Government supervision.

The number of shops has been increased so as to bring the drug within reach of those entitled to use it. The Excise staff has been very largely increased, and there is now a resident Excise officer in each shop. It is believed that the result of these measures has been a distinct check to the contraband trade, owing to the displacement of illicit opium by Government opium sold to authorised consumers at licensed shops, but that the measure has not been altogether successful in restricting the use of opium and in keeping it out of the hands of non-registered Burmans. An opportunity was given to those who had failed to register themselves as opium consumers in 1893, to come forward and do so. This opportunity was taken little advantage of, and this is not much to be wondered at, as opium consumers are much looked down upon by orthodox Buddhists, and to register himself as an opium consumer is looked upon by a Burman much as to register himself as an habitual drunkard would be looked upon by an Englishman.

The opium revenue suffered somewhat by these new measures; but, even if it had suffered more, there would be no hesitation in incurring loss of revenue if the object of the opium regulations could be attained.

The total revenue from Excise and opium in 1902 and 1903 was Rs. 29,01,045. The use of hemp drugs is prohibited throughout Burma, and their importation into Burma is also prohibited. The prohibition is frequently evaded by Indians who are accustomed to use this drug. Ganja or hemp is used medicinally for elephants, and a supply for this purpose is always obtainable from confiscations.

Salt Manufacture.

Another much contested question is the manufacture of salt in Burma. At present the idea is to tax salt of local manufacture at the same rate as imported salt, viz., at one rupee per maund of 82 lbs. Salt is manufactured in both Lower and Upper Burma. In Lower Burma it is for the most part made along the sea coast by evaporation from salt water, and in Upper Burma it is manufactured from brine obtained from natural salt springs. About 5,500 families are engaged in salt manufacture, and prohibition of the manufacture of salt in Burma would throw these families out of employ, at all events for a time. If salt of local manufacture can be so taxed as to give it no undue advantage in competing with imported salt, the manufacture of this salt would not be injurious to the revenue. The great difficulty is to find a means of taxing this local salt which will prevent the manufacture of more salt than the Excise assessments cover.

Up to 1902 the custom had been to levy a duty on the vessels employed in the manufacture of salt calculated on the quantity of salt each vessel is estimated to produce. In 1902, in certain prescribed areas, free licences to manufacture salt were issued and the salt so manufactured had to be stored and duty was leviable only when the salt was sold. The salt boilers at first refused to work on these terms, but now they have been accepted in two districts, and, if the experiment proves successful, the new system will be generally adopted. Of salt imported into Burma, 60 per cent. came from Germany.

Salt is largely used in the preparation of "Ngapi," which is a preparation of fish largely used by Burmans; indeed, "Ngapi" is a daily article of diet with Burmans.

The fishery revenue of Burma is very large. In 1902-1903 it brought in Rs.28,38,846. The whole question of fisheries has been reported upon lately by a special officer, Major Maxwell, who takes great interest in the subject, and many of his recommendations for the improved

management of the fisheries have been adopted.

Mines and Minerals.

There is no doubt that Burma contains considerable quantities of minerals. The minerals worked at present are petroleum, rubies, gold, tourmaline, jade, amber, mica, steatite, tin, lead, and silver. There are other minerals, such as iron, plumbago, and antimony, and probably, as the development of the country proceeds, much mineral wealth will be discovered.

The most valuable mineral worked now is petroleum. There is petroleum in the Akyab and Kyaukpya district of the Arakan division, but it has not been found in paying quantities, though it has been worked for years.

In Upper Burma there are large petroleum fields at Yenangyoung and Yenangyat, in the Magwe and Minbu districts, and petroleum has been found at Singu, to the North of the Yenangyoung fields in the Myingyan district. The Government duty on petroleum is eight annas (eightpence) per 100 viss, which equals 365 lbs.

The depth of the oil wells worked by Europeans on the Canadian principle is usually from 200 to 300 feet, but some are very much deeper. Petroleum is worked by the natives in a primitive manner with shallow wells worked by hand.

The Burma Oil Company have two large refineries, one at Rangoon and the other at Syriam, which is a little below Rangoon on the river.

The company also own tank steamers in which it is sent to India in bulk. There are smaller refineries owned by other companies at Yenangyat. The oil of Yenangyoung is rich in paraffin wax. The royalty on petroleum in 1902-1903 amounted to 8 lakhs of rupees, and the petroleum industry is well established and increasing.

The ruby industry is leased to the Ruby Mines Company, and is proving remunerative. In July, 1902, the mines were flooded by heavy rain, but this year the company has declared a dividend of 15 per cent. A new lease has lately been granted to the Ruby Mines Company, which should encourage them to invest more capital in the undertaking. The mines are at Mogok in the ruby mines district.

Rubies in small quantities are found in the Myitkyina district in the extreme north of Burma, where they are worked by Chinamen, and at Sagayin in the Mandalay district in the marble quarries. Jade and amber are found in the Myitkyina district. Gold was found in the Katha district, where a company was formed to work it. The reef on which the company was working has been exhausted. Another company is dredging for gold on the Irawadi river above Myitkyina, and is meeting with success. Companies have, I understand, been formed to dredge for gold on the Chindwin river and on the Sittang river near Shwegyin. Gold is washed by the natives on the Chindwin and Sittang river and also on Uyu river, which is an affluent of the Chindwin. Shortly after annexation the people on the Uyu river paid in their revenue in gold.

The Burma Coal Company work coal at Letkokbin in the Shwebo district. The coal is not of very good quality and the difficulties of transport are much in the way of the company. The coal has to be carried to the river some six or eight miles distant by tramway and then sent to Mandalay by flats belonging to the Irawadi Flotilla Company, and there placed on railway trucks. The only customer for the coal is the railway company, and the coal suffers much from frequent handling. The mines might be connected with the Mu Valley railway by a short branch line about 20 miles long if the capital to build the line could be found.

There is an excellent coal-field on the Chindwin river, another at Lashio on the Mandalay-Kunlon line which the railway company contemplate working. There is also coal in the Tenasserim division, at Thayetmyo, and at different places in the Shan States.

Tin is found in the Tavoy and Mergui districts of the Tenasserim division, where it has been worked for years by Chinamen. A company is also working tin in the Mergui district. Previous companies formed to work tin have not been successful.

Tourmaline is worked in the ruby mines district, steatite in the Pakokko and Minbu districts, silver and lead in the Southern Shan States. The working of mica in the ruby mine district has been abandoned. The want of sufficient labour is much felt in mining enterprises. The Burmese population is sparse, and, where a living can easily be got from the land, there is no great attraction to work in the mines. Cultivable land is abundant, and anybody who can provide the small capital to buy plough cattle and the necessary agriculturural implements can break up waste land, which he can take up under a few simple rules

Burmans, particularly in Lower Burma, are well-to-do. They live and dress well, and can afford to spend money on pagodas and festivals. The Burman is not given to saving, and, when he has put by a little money, he takes a holiday to spend it. He does not think of using his capital to make more or of making provision for his family.

Taxation in Upper Burma was much heavier in the time of the monarchy than taxation in Lower Burma, and the people were not so well off. The rainfall in Upper Burma is more precarious and the crops in the upper province are sometimes a failure. Upper Burmans, therefore, often migrate to Lower Burma to work in the rice-fields and to help in getting in the harvests. Many of them take up land and remain in Lower Burma. Employers of labour in Burma have, therefore, to depend mostly on imported labour, which can be obtained from India or China. Imported labour is expensive, and imported labourers often desert for more remunerative undertakings. There have been a good many schemes for importing the surplus population of congested districts in India to Burma. They have generally been failures. The only one that has had any measure of success is that of Mr. Milne. This gentleman was granted 30,000 acres of land in the Shwegyin district of Lower Burma. He brought over settlers from Behar, from, I believe, his own estates there. He supplied the settlers with all they required until they had broken up land and made themselves self-supporting. He gave much personal attention to the scheme and spent a good deal of money on it, and above all he had influence over the settlers who had relations on Mr. Milne's Behar estates. It will be some years before the settlement will commence to repay the money expended upon it, but the experiment promises to succeed. Under an arrangement with the Government of Bengal immigrants from Behar and Chotia Nagpur can get a free passage to Burma, but not many have availed themselves of this privilege, and, until there is direct communication by rail between India and Burma, no large influx of Indians into Burma is to be expected.

Large numbers of coolies come from Madras every year to work in the rice mills and in the fields, but the great majority return to their homes at the end of the season, and only a small residuum remains in Burma. A good many military policemen, principally Gurkhas, marry Burmese wives and settle in Burma. They find ready employment in keeping dairies, which the Burmans never do, and are sometimes found in the most out-of-the-way places. In spite of all this labour is scarce in Burma, and is likely to remain so for many years.

It will, I think, be a bad day for Burma if ever the easy-going, laughter-loving Burmans are elbowed out of their own country by thrifty and pushing Chinamen and natives of India.

Conclusion.

In what I have said about Burma I have endeavoured to give a brief account of Burma, showing how the country has gradually come under British rule, what is the character of the country and its people, what the laws and customs of the country are, and what our system of administration has been.

Considering that no part of Burma was under British rule before 1826 it may, I think, be claimed that the country has amply repaid our efforts to bring it under settled administration and to secure its progress and development, and the happiness and content of its people.

My difficulty in dealing with the subject has been how to condense the matter before me within reasonable bounds, and in my endeavours to be brief I have omitted a good deal which I might have said had it not been for my fear of wearying my audience. As it is, whilst I have not, perhaps, escaped from being tedious, I trust I have succeeded in giving you some idea of what a valuable acquisition Burma has been to the British crown.

Great progress has been made since the country came under British rule. To take over a country, which had hitherto been administered in the roughest and readiest manner, and to apply to it all the methods of civilised Government, must always be an arduous undertaking.

When we took over Upper Burma, we had to equip it, as we had previously to equip Lower Burma, with every kind of building needed for civilised administration. Courts of law, police stations, post offices, telegraph lines and offices, barracks, jails, were all wanting, and there were no proper houses for officers. All these have been or are being supplied. There is still something left to be done both in Upper and Lower Burma. For instance, the increase of cultivation, population, and revenue in the delta of Lower Burma, have made it necessary to add another district to the Irawadi division, in spite of the fact that an additional district had already been created ten years ago. Then the work of the civil officers

has so increased in Lower Burma that a separate judicial service is now found to be required as executive, revenue, and judicial work can no longer be carried out by single officers. All this means additional expenditure. Fortunately, the revenues of Burma have hitherto constantly increased from year to year, and with the large area of cultivable waste, which is being gradually brought under the plough there is no immediate chance that the limit of expansion of revenue will soon be reached.

Burma seems to me to offer a very favourable field for the investment of capital, and as the country becomes better known more and more capital will, I feel sure, be attracted to it. In any case trade must increase, and, so far as I can foresee, the prosperity of Burma is likely to continue undiminished.

If nothing else could be said for British administration in Burma, it may be at least asserted that the condition of the people has been improved under our rule. There has been a considerable advance in the market price of produce, and in many districts, where the rates were settled some years ago, the people have had the full advantage of this advance. Statistics show that the indebtedness of the people is on the increase, but this is, I take it, not any indication of poverty, but it is due partly to the fact that Burmans are naturally extravagant, and partly to the fact that they have borrowed money in order to increase the area of their cultivation. Grants of waste land are keenly competed for.

There has never been any general scarcity in Burma. There was scarcity in three districts of Upper Burma in 1896-7, but even in that year 18,000 people were the maximum employed at one time on famine works. The food supply of the province is greatly in excess of the needs of the people and there is always a large surplus available for export. The wages of labourers show a constant tendency to increase, and pauperism is practically unkown.

The number of tourists who visit Burma is steadily increasing, and to those who have not visited Burma may be strongly recommended to do so. There is beautiful scenery, an interesting people willing to welcome visitors, large and small game shooting for those who can find time to enjoy it, archæological remains to be studied, and those who are in the fortunate position of having capital to invest might easily do so to their profit in Burma.

There is a great field for an agricultural bank (similar to the Agricultural Bank of Egypt) in Burma, and many other openings might be found for the employment of capital in Burma; 24 per cent. is now readily paid for loans to agriculturists on good security, and the development of the country is much retarded by the scarcity of capital.

The climate is, of course, not suitable to European settlers. In Lower Burma, March, April, and May are dry and hot. In the rains it is not so hot except when the rains hold off for a day or two, but it is very damp. November, December, January, and February are the pleasantest months, but even in those months it is seldom cold. In Upper Burma, the climate is much drier. It is very hot in the summer, but much colder from November to March. In the hills, the climate is more bearable.

Before bringing this paper to a close, I should like to allude briefly to a recent suggestion that Burma should be separated from India, and made a Crown colony, being united with the Straits Settlements and Ceylon. The relations of Burma with the Straits Settlements and Ceylon are very slight, whilst she draws her army, her covenanted Civil Service, her Indian Marine vessels, her military police, and a great part of her labour from India. Burma was conquered by India at a great expense of men and money, and has hitherto been administered from India.

Her laws are mainly adapted from those in force in India, and there is next to nothing in the Burma system of administration which conforms with those in force in the Straits Settlements or Ceylon. It is true that I have observed that the development of railways in Burma suffers from the fact that Burma has to share with other provinces of India in the distribution of the capital available for railway construction, but, I think, that a plan might easily be desired whereby Burma would obtain financial control of her own railways, and that, in this manner, she might be able to accelerate the opening out of her resources by means of new railways. Burma, it must be remembered, is a new province, and requires a larger expenditure upon railways, communications, and public works in general, than the older provinces of India.

Besides this the frontier policy of Burma has, hitherto, been directed from India and, so far as I have been able to judge, it has been directed with great efficiency and, if Burma became a Crown colony, her frontier policy is so interwoven with that of India, that India would still have to exercise a pre-

dominant voice in all political questions affecting Burma. In case of trouble in Burma or on her frontiers, it is to India that she would have to look for assistance.

In my opinion, Burma would lose a good deal more than she would gain by being separated from India even if she were constituted a separate Crown colony, and I can see nothing that she could gain by being united to the Straits Settlements or to Ceylon.

It is urged that the Straits Settlements and Ceylon have prospered greatly as Crown colonies. Burma, too, has made great progress as a province of India—Upper Burma was only annexed in 1886, and was then in a state of anarchy. For some years all the energies of Government were devoted to the pacification of the province, and it was only when this task was accomplished that attention could be given to commercial and industrial progress. Since peace was secured Burma has certainly not stood still, and I have every confidence that the progress of Burma as a province of India will continue to be rapid enough to satisfy her most ardent well-wishers. I doubt myself whether the people of Burma have any unanimous wish to be separated from India, and I do not see how the separation could be accomplished without injury to the province, as it would involve a complete change in more than one direction.

DISCUSSION.

The CHAIRMAN said that they were all very much obliged to Sir Frederic Fryer for the very interesting paper he had read. If anyone wished to know more about Burma he would recommend two books, one being "The Burman," by Shway Yoe, the *nom-de-plume* of Sir George Scott, which was one of the best works that had been written about any country. The other book was "The Soul of a People," by a well-known officer of the Burma Commission; it gave a most charming account of the Burmans, their religion, and their feelings; rather, he thought, from too rosy a point of view, but still, it was full of kindliness and grace and well worth reading. The main characteristic of the Burman was his instability. He was a devil-may-care fellow who gave no thought for the future and very little for the present. That was why they had never been able to make him a good soldier. They had been able to get from the natives of other countries a contingent for the Army, but it was impossible to impress upon the Burman any such sense of duty as was required as an elementary part of a soldier's business. He remembered one case where they tried to raise a military police composed of Burmans, but they had to give the idea up. A Burman was put on sentry, and he would say to the first man that came along, "Take hold of my musket and keep it while I go to the theatre, and I will give you a sixpence." That spirit prevailed throughout the whole of the country, but at the same time they were most charming people, and the country was delightful in many ways, except for the extremely damp heat. There were also the mosquitoes, which would prevent anyone from falling into too sound a slumber. When he was at Rangoon some of the ladies used to put their feet into large mosquito bags and tie them up during dinner, otherwise they could not have existed for a moment without fidgeting about and feeling exceedingly uncomfortable. A Burma mosquito could get through a mosquito curtain as easily as a burglar could enter an unprotected window. However, those were minor things in a splendid country, a country that was prospering and would continue to prosper more and more. One reason for that was there was a large and enterprising mercantile community of Englishmen and Scotsmen, with a strong contingent of Germans, now in Rangoon, and they were the real force to push the country on. The Government was there mainly to keep order and secure fair play. He himself should like to see a communication opened between Burma and China. Many people had laughed at him for advocating this, but he had never lost sight of the possibility of opening up railway communication between Burma and Yunnan, and until that was done he did not believe that they would reap the full fruit of their enterprise in Burma. If a careful survey of the country, which had not yet been made, showed the scheme to be impossible, then, of course, they must put up with what they had, but he hoped that sometime or other, the project would be carried out. He thought that when Lord Dalhousie in the second Burma war extended our frontier up to Thayetmyo, he had some hope that there would be a great commerce coming down the Irawadi Valley, not only from the upper parts o Burma, but from China. The Chairman concluded by expressing his great pleasure at having been able to welcome Sir Frederic Fryer that afternoon and to hear that the Burma which he left 14 years ago was very much the same now as then.

Mr. JOHN HALLIDAY, as an old Anglo-Burman, observed that what he had to say must take the form of thanks for Sir Frederic Fryer's very painstaking and unvarnished account of the province which he had so long and successfully governed. They must all thank him for continuing to take an interest in that province, and he (the speaker) hoped Sir Frederic would continue to do so for many years to come. The author's story of the man who was drowned reminded him of a similar incident. When he was in Bassein a man was bound hand and foot and tied up in a mat and then pushed off the pier into deep water. They waited some time and there was

no sign of him, and although he (the speaker) was a magistrate and justice of the peace, he thought he would be tried for abetting murder, and pictured himself dangling at the end of a rope. He broke into a cold sweat and turned away, but to his great joy when he got to the end of the pier the "drowned" man was running along the bank. With regard to the proposal to disconnect Burma from India, he thought it was a crazy idea. Burma had made great progress hitherto and there was no reason why it should not continue to do so. It had the pick of the Bengal civil servants for its officials, its commissioners and lieutenant-governors, and from his experience of close on 50 years he should say leave well alone. With regard to the railway at Lashio, it was stated that it did not pay, but no line in the same condition would pay. They had made the railway to end nowhere. The London and Brighton Railway would be in the same position if it ended at Hayward's Heath. If they carried the railway into Yunnan and down to the Yangtse, he had not the least doubt that, in the course of time, it would be a very large concern. Unfortunately, the present Viceroy had rather set himself against the idea, and they must wait till he came home before they could do anything. On behalf of the audience, the people of Burma, and himself, he thanked Sir Frederic for his able paper.

Dr. John Pollen, C.I.E., said it might possibly be asked what could a Bombay man know about Burma. He thought Bombay men knew a good deal more than they sometimes got credit for. At any rate, he did know something about Burma, and he knew much more about it than he did before that evening, after listening to the admirable paper. He was certainly in a better position than the Member of Parliament who, meeting an officer who had just returned from fighting in Burma, asked him about the country, and then said, "I always heard it pronounced Bermuda." His (Dr. Pollen's) own knowledge of Burma commenced very early, in 1874, when he was summoned with other Bombay officers to save the perishing millions of Bengal from famine. He had had a good deal to do with Burma rice and colossal cash advances. His next experience was when he had, should he call it, the privilege of acting as quasi-gaoler to King Thebaw, on which occasion he also made the acquaintance of the Queens whom they had seen on the screen that afternoon. King Thebaw was much finer-looking than the picture shown represented him to be. The only troublesome member of the party was the old Queen Mother. He remembered her very distinctly. When he had met other Indian Queens, they had always been very carefully wrapped up in muslins, and concealed behind curtains, but this lady was distinguished by an absence of such drapery. She insisted on an interview with him, and in the most impassioned language, which he could not understand, she denounced, as he was afterwards informed, the Government of India for their meanness and shabbiness in not providing her with a carriage. She thought it was a great shame that she was obliged to petition her son to lend her his carriage. The last he saw of the King was about two and a half years ago, and he thought Sir Frederic Fryer would be interested to know that Thebaw's education was being advanced, and that he now spoke English fluently. He told him (the speaker) in very good English that he was certain he was a far happier man cultivating his little garden at Rutnagherry, than he ever would have been if he had been allowed to remain ruler of the Burmans; so the British Government had not done him a bad turn in depriving him of the responsible office he once held. He (Dr. Pollen) also had the honour of conducting a representative of Burma at the time of the Coronation, and he was then privileged to learn a little more of the manners and customs of the Burmans, and altogether his experience induced him to form a very high opinion indeed of their character. They certainly knew how to take things very easily, but while making themselves happy they endeavoured to make others happy also.

Mr. Martin Wood said that consequent on the annexation of Upper Burma, the expenditure increased by many millions in the following years. Had the large excess of income over expenditure that British Burma previously boasted of, by this time made up for cost of the conquest?

Sir Frederic Fryer said he understood that last year the revenue of Burma exceeded the expenditure by about two millions sterling.

On the motion of the Chairman, a vote of thanks to the author was carried unanimously.

CANTOR LECTURES.

MUSICAL WIND INSTRUMENTS.

By D. J. Blaikley.

Lecture III.—Delivered December 12th, 1904.

I propose connecting the subject of the last lecture, "Brass Instruments," with that before us this evening, which is "Reed Instruments," by some experiments showing the presence of partial tones in notes produced from examples of each class. Partial tones may be either harmonic or inharmonic, but at present we need only consider those which are harmonic, or stand related to the prime tone (which gives the name to the note) by their vibrational periods being in arithmetical progression of whole numbers. In most distinctly musical qualities of tone, these partials are heard up to the sixth or eighth; in some qualities much higher partials, even up to the sixteenth or

twentieth, can be detected, and in some, the even numbered partials are either altogether absent, or very weak. This latter condition arises in instruments like the clarinet, the peculiarity in the proportions of which will presently be described.

By means of resonators, or tubes adjusted to the pitch of the partials which may exist in a compound tone, such a tone can be analysed. I have here a few resonators which, in this case, are tubes adjustable in length, and closed at one end with diaphragms of gold-beater's skin. Against each diaphragm or drumhead a small bead is suspended, and the disturbance of this bead shows that the resonator is answering to a vibration in its neighbourhood. This vibration may in its wave form stand for a simple or prime tone, or may be but one component of a complex wave form, isolated by the resonator from the general mass of tone.

[Experiments with resonators.]

Such experiments as these prove that the compound character of musical tones is not a mere scientific theory, useful as a working hypothesis, but is a matter capable of very direct proof.

In these experiments I have somewhat anticipated matters which should properly have come under consideration later in the evening, but the difficulty of keeping the resonators tuned in an atmosphere varying in temperature and moisture must be my excuse.

Reed instruments fall under two main divisions, as will be seen by reference to the Table of Classification, according to the type of reed used, which may be either double or single. We wlll throw on the screen representations of both. The double reed, seen in elevation and also foreshortened, that the space between the two blades may be seen, belongs to the bassoon, and represents also the principle of the oboe reed. The single reed fitted to a mouthpiece is from a B flat clarinet: the saxophone has a similar reed, but its mouthpiece differs somewhat from that of the clarinet. The general action is the same in every case. The air, being under some slight pressure in the player's mouth, is driven through the chink between the blades of the double reed, or between the single reed and its mouthpiece. As a steady, unvarying pressure on the reed cannot cause vibration but merely deflection, it is evident that the sum of the internal and external pressures upon the reed must vary in intensity.

Something of the action of a musical reed may be illustrated by the behaviour of a slip of wood under weights differently applied. This slip or lath of wood is clamped at one end, but its other end is free to move under certain conditions, and it may be taken to represent a clarinet reed. In its normal position it is at rest, and it is also at rest when loaded at its free end. This second condition represents the reed under pressure differing on its two sides, when the difference is unvarying. If the load is applied suddenly the slip vibrates, but ultimately, through molecular friction, and other causes, comes to rest in the second position. In the actual reed, the varying total pressure by which its vibration is maintained, is due to induced currents on the inner side, or side next the associated tube, the variation in the chink between the reed and the mouthpiece being the immediate cause of these.

Reeds very roughly produced suffice to give continuous tones, which may be fairly musical so long as they are confined to one note, or to a very limited range of notes, but for a reed to speak well over the great compass of some of our modern instruments, it must be fashioned with much care and delicacy.

The relationship between the natural pitch of the reed, *i.e.*, its own rate of vibration, and the pitch of the tube to which it is applied is worthy of some slight reference and examination. The question is sometimes asked, "Does the reed control the pitch of the air in the tube, or does the air control the pitch of the reed?" The correct answer is that they control each other: a strong reed controls the comparatively light mass of air in the tube, but the lighter and more delicate the reed the more it is itself controlled by the mass of air in the tube.

I have here a harmonium reed of metal with which tubes can be associated and their influence upon the speech of the reed manifested. The reed itself speaks at a pitch of about 1024, or an octave higher than our highest fork. Acted upon by the same wind is another reed slightly out of unison with it, so that beats between the two can be heard. We can make the first mentioned reed speak through a short length of tube fitted with a telescopic slide or cover to regulate its length, and you will notice that with changes of length the rapidity of the beats changes. This change of pitch is, however, not nearly so great as the corresponding change in the length of the tube, and the result obtained shows, therefore, that this metal reed can accommodate itself to a slight extent to the natural rate of vibration of the air in the

tube. Or to put the case another way, the air in the tube can be thrown by the reed into a forced vibration foreign to its natural period. There is, however, a limit to this, for with certain lengths of tube all sound ceases.

It might be imagined that the addition of tube, and a consequent addition to the mass of air to be thrown into vibration, could not improve matters, but this is not the case, for the condition to be obtained is one of sympathy between the reed and the resonating air column. As the experiment proceeds, you will notice that as lengths of tube corresponding to a quarter, three-quarter, and one and a-quarter wave-lengths are added to the length giving silence, speech is resumed, whereas when lengths agreeing with the half or whole length are added, silence is maintained.

The light cane reeds used for reed instruments adapt themselves much more readily than metal reeds to alterations in the natural pitch of the air column, but, out of the several notes possible from a given length of tube, the particular one required is obtained by the control of the lips over the reed, and we may regard the first great step in the artistic development of reed instruments to have been the removal of the reed from a mere air-chamber, and the placing it under the control of the lips. Mainly by this means the compass of an octave or so on the bagpipe chanter has been extended to a compass of between three and four octaves on the bassoon and clarinet.

Each of the main divisions of single and double reed instruments are further sub-divided into those with cylindrical and those with conical tubes.

As was remarked during the first lecture, the bagpipe drone may reasonably stand for the simplest type of single reed, and from the facility with which it can be cut, it is very possibly the oldest. It is, however, tolerably certain that both single and double reed instruments were in use in the earliest historical times. Here are copies of two Greek "flutes" now in the British Museum, which are really reed instruments, but whether single or double reed is somewhat uncertain.

The scale on all reed wind instruments is obtained by varying the length of the resonating air column by means of side-holes. The diatonic scale can be obtained by the cutting of six side-holes, closed by the fingers, which holes give (assuming the fundamental pitch to be C) *c*, *d*, *e*, *f*, *g*, *a* and *b* respectively, the sixth or *b* hole serving also when the other holes are closed to facilitate the production of the octave of the prime tone. Other octave notes can be produced on a conical instrument by varying the action of the lips on the reed, but semi-tones lying out of its normal scale are false or weak.

On our scheme of classification bagpipes are given as illustrating the family of enclosed reeds, or reeds uninfluenced by lip pressure. As these instruments are all supplied with wind delivered from a regulating bellows or reservoir, and not directly from the lungs, they stand on the limiting line which divides our subject from the organ class of instruments; indeed, Mr. Henri Lavoix, in his work, "La Musique au Siècle de Saint Louis," fitly describes the bagpipe as the organ reduced to its simplest expression. In one group of bagpipes the reservoir is supplied from the lungs, but, in the other, it is supplied from a small feeder worked by the arm; the Irish or Union pipes, and the Northumbrian pipes belong to this group, also the delicate musette, which was fashionable in the reign of Louis XIV., and was introduced into the orchestra by Sully. The most important member of the first group, at the present day, is the great Highland, or military bagpipe, which has a conical chanter, or melody pipe, played with a double reed, and three drones with single reeds, two of which are tuned in unison in A, and the third an octave lower. The scale of the chanter is peculiar, having its two minor thirds divided, not into a whole tone and a semi-tone, but into two intervals of three-quarters of a tone each. As this division is known in some Eastern scales, it is possible that the bagpipe chanter scale is Arabic in its origin.

The passing away of other once popular instruments, such as the cromornes, which were sounded by reeds enclosed in chambers, and therefore removed from the regulating power of the lips, appears to be due chiefly to their unsuitability for the rendering of really artistic music. At the present time, all reed instruments used in the orchestra have their reeds directly under the control of the lips of the player. The first family to be considered comprises oboes and bassoons: these are conical, double-reed instruments, having their proper tones in the harmonic series, 1, 2, 3, 4, &c. They are the modern representatives of the old schalmeys or shawms, bombardts, and pommers. The fingering of all these was based upon the six finger-hole scheme, and on the bass instruments one or two extra lower notes were obtained by the use of open-standing keys. It was noticed in speaking of the

general scale system, that the sixth hole could be used to facilitate the production of the octave of the prime tone. In the modern oboe, the successor of the discant schalmey or treble shawm, two very small holes are introduced above the sixth finger-hole; these are controlled by keys, and give certainty to the production of the upper harmonics, by preventing the establishment of nodes in their neighbourhood.

Although a few keys in addition to the finger-holes suffice to give a chromatic scale, in all modern work these are supplemented by many others, serving the following three purposes:—1st. The extension of the compass downwards: this extension in the oboe carries the pitch from D to B flat. 2nd. The production of shakes. 3rd. The production of many notes by alternative fingerings.

The downward extension of compass by means of keys is well seen on the bassoon. This instrument is an improvement on the old bass shawm or pommer, which was very cumbersome owing to its great length. The tube of the bassoon is doubled upon itself, and therefore the two thumbs can be brought into use to close holes lying below the six finger holes, and also to work keys which still further extend the compass downwards. By these means the lowest note of the bassoon, B flat, is two octaves below the lowest note of the oboe, although its general pitch is only a twelfth lower; for instance, with the three left-hand finger-holes closed the oboe gives G and the bassoon C, an octave and a fifth lower.

The cor-anglais is an instrument of the oboe type and characteristics, but one-fifth lower in pitch, and between this instrument and the ordinary oboe comes the oboe d'amore.

Instruments of the bassoon type have also been made in various keys, but the only variety of any importance is the double bassoon, or contra-fagotto, in pitch an octave lower than the bassoon proper.

These, the oboes and bassoons and their congeners, are the only double reed instruments now in use, and they are all conical tubes, overblowing to the octave, twelfth, &c. With the single reed instruments the case is different, for the most important of these, the clarinet, is an instrument with a cylindrical tube, expanding to a bell only at its mouth and overblowing to the twelfth.

The modern clarinet is derived from the chalumeau, a rude instrument made from a natural reed, in which a speaking tongue was cut near one end, and also six finger-holes and one thumb-hole. The distinctive feature of the clarinet as invented, or at least developed by Denner, is the use of one hole, covered by a key, both as a note-hole, and as a speaker to facilitate the overblowing to the twelfth, for, the clarinet having a cylindrical tube, the octave harmonic No. 2 is absent. The notes which cannot be obtained from the customary six finger-holes, even when supplemented by a seventh, or thumb-hole, are obtained by key-work, which is absolutely necessary on the simplest clarinet.

The most modern of the reed instruments is the saxophone, which has a conical tube, and a single reed and mouthpiece, very similar to those on the clarinet. The instrument was invented by Sax in 1840, and being conical, overblows to the octave, and in the general arrangement of its keys, is very similar to the oboe. Although but little known in this country, it holds an important place in the French military bands.

The lecture was illustrated by the following programme of music:—

Oboe solo, Concertino, *Guillhaut*, Mr. J. L. Fonteyne. Clarinet solo, Concertino, *Weber*, Mr. Charles Draper. Bassoon solo, Adagio from Concerto, *Mozart*, Mr. E. F. James. Trio: oboe, clarinet, and bassoon, *Huguenin*. At the pianoforte, Mr. R. H. Walthew.

RUBBER IN THE GOLD COAST.

The cause of the preparation of the Report,* by Mr. W. H. Johnston, the Director of Agriculture for the Gold Coast, with its supplementary historical note by Sir W. T. Thiselton Dyer (the Director of the Royal Botanic Gardens, Kew), and report by Mr. C. W. Smythe, the Curator of the Botanical Stations in Sierra Leone, is due to the extraordinary recent decline in the rubber exports of the Gold Coast. An industry which in 1899 exported goods valued at £555,731, and in 1903 exported only a value of £196,500, certainly called for investigation. As may be imagined from the reports from other rubber-producing countries, this has been due mainly to ruthless tapping by improvident natives, and to the tapping of immature trees. As a consequence, practically all the rubber plants have been exterminated from the coast to as far as a week or ten days' journey inland. The report therefore considers what steps should be taken to replant trees best adapted for cultivation in the colony, which will give a return on the expenditure initially incurred at as early a date as possible, at the same time yielding the

* "Colonial Office Reports," Miscellaneous, No. 28, 1904.

largest percentage of rubber of good quality. The probabilities of the six varieties generally considered as most valuable are carefully discussed. As has happened elsewhere, the *Castilloa elastica* is peculiarly susceptible to insect pests. The best results have been obtained from the *Funtumia elastica* and the *Hevea brasiliensis* varieties. Experiments at Aburi have proved that the former should not be tapped before its ninth year, then it will yield two ounces of dry rubber per tree. It is, however, susceptible to serious damage from the larvæ of a moth, known as the *Glyphodes ocellata*. Repeated applications of lime and ashes seem to be about the best methods of exterminating this pest. The *Hevea brasiliensis*, since its introduction into the colony, has been remarkably free from insect and fungus pests. Mr. Johnston and Mr. Smythe both concur in recommending this variety as yielding better results under cultivation than any other known plant. Four trees, ten years old, tapped for the first time in 1903, yielded 67 ounces of dry rubber, or 16¾ ounces apiece without showing signs of having suffered in the slightest degree. The heavy rainfall on the West Coast and rich soil are alike considered favourable. Mr. Smythe reports the Sierra Leone rubber industry as nearly dead, and unlikely ever to be revived, unless taken up in earnest by enterprising Europeans. From the natives who have so avariciously destroyed a valuable industry, little is to be hoped. On one occasion, Mr. Johnston caused some 15,000 rubber plants to be propagated at the Aburi Botanical Gardens, offering them free to native chiefs in the immediate neighbourhood. Only about one-tenth of these were accepted, and the remainder had to be planted out at Government expense in the Aburi and Kola plantations.

ART-TRADE SCHOOLS IN GERMANY.

As far back as the beginning of the nineteenth century instruction in art-trade drawing was inscribed upon the programme of the numerous industrial and polytechnic associations founded in Germany for the promotion of industrial development. But the aim was rather technical efficiency than artistic finish. The first object was the replacement of foreign manufactured goods by the products of home industries; and the instruction given was devoted principally to the inculcation of the mathematical, scientific, and commercial knowledge necessary for the progressive requirements of modern industrial life. Great attention was paid to accuracy in constructive drawing, and the adoption of new and improved methods of manufacture. Interest in art, the formation of taste, the production of wares not only technically perfect but combined with artistic finish were relegated to the second place. Nor is there anything surprising in this when the condition of the German States during the period following the Napoleonic wars is remembered. The reaction and exhaustion were so great, the lack of capital, and economic misfortune were so widespread, that few were in a position to embellish their homes and surroundings by the acquisition of artistically wrought goods. It was not until after the Great Exhibition of 1851 that the movement for the foundation of art-trade schools in Germany began, and they owed their inception and development to the desire to compete with France in the production of artistic wares, and the endeavour to succour handicrafts menaced by the general adoption of machinery, by gradually transforming them into art-trades. The United Kingdom was the first country to profit by the lessons of the Great Exhibition. The creation of the Department of Science and Art and the South Kensington Museum, mark the first systematic attempt to place the art-trade industries of the country upon an independent national basis, and to promote and control their development. Germany followed in the wake of Great Britain, but her art-trade schools and museums, founded during the latter half of the last century, whilst using British models to some extent, were shaped by the educational views prevailing in Germany, a distinguishing feature being the promotion of intimate relations between the aims of the schools and the needs of the local and district art-trade branches of industry.

The general aim of the art-trade schools in Germany, writes Dr. Rose, His Majesty's consul at Stuttgart, in his very interesting report on art-trade schools in Germany, just published ("Miscellaneous Series, Diplomatic and Consular Reports," No. 621), "is briefly the application of art to industry, the endeavour to impart the methods and develop the faculties for the utilisation of the graceful and harmonious in nature, in the production of the ordinary practical objects of trade and daily use. To durability and serviceability, the two cardinal principles necessary in the production of goods, are to be wedded grace of form and harmony of colour. The art-trade worker must not be a mere mechanical producer of useful wares, but must imbue his work with the sense of the beautiful drawn from the measure of his own talent and his contemplation and interpretation of the great book of nature." Dr. Rose says that the movement in Germany in favour of art-trade instruction is still in an experimental and tentative stage, and some time must yet elapse before anything like uniformity is attained in the methods of instruction, or unanimity arrived at regarding the cardinal principles of art involved in art-trade instruction. Taken as a whole the art-trade schools have not yet attained the efficiency of the technical schools. A weak point is the paucity of instruction workshops and the insufficient equipment and accommodation of those already installed, shortenings due to the lack of necessary funds and imperfect appreciation of the important *role* played by such workshops in art-trade instruction. Still the art-trade schools have beneficially influenced the art-trade products of Germany, and if these products continue to show much that is undesirable the explanation is to be found partly in manufacture solely for purposes of profit, and partly in the indifference of an indiscriminating public.

AUSTRALIAN RAILWAYS.*

In a country like Australia, in which are to be found immense districts untraversed by navigable rivers, railway construction becomes a pressing necessity for the purpose of providing a means of communication between the leading ports and the interior, but the limited population of the six federating States, barely four millions at the close of 1903, has precluded the idea of the work being conducted by private enterprise, although the earlier attempts were a result of individual effort. As the main object of Australian railway construction is to assist in opening up and developing the country, rather than providing dividends for shareholders, each of the State Governments has had to assume the responsibility of constructing its own railway system, for which purpose considerable sums of money have been borrowed, the total loan expenditure for that purpose to June 30, 1904, being £136,600,855. Practically, railway construction constitutes the leading item of Australian indebtedness: the loan expenditure on all other works, including telegraphs, telephones, water supply, sewerage, harbours, rivers, navigation, roads and bridges, public works and buildings, defence, &c., amounting to only £83,520,606. Nearly the whole of the Australian public debt, £227,637,163, unlike that of most other countries, has been expended in connection with railways and other public works, which, at the present time, represent a value several millions in excess of Australian public obligations. The various States may have borrowed somewhat freely, but they can show substantial security for every shilling of loan money obtained. In 1903-4, the total length of railways open for traffic in the Commonwealth was 14,464 miles, of which Victoria possessed 3,381 miles, New South Wales 3,362 miles, Queensland 3,030 miles, Western Australia 2,170 miles, South Australia 1,901 miles, and Tasmania 620 miles. The progress of construction has become increasingly rapid during each successive decade, which explains in some measure the frequency of recent borrowings. With the exception of 640½ miles constructed in connection with mining, timber-getting, and other industrial enterprises, the whole of the railways are the property of the respective State Governments. In New South Wales the State railways are placed in charge of three Commissioners, and of a single Commissioner in Victoria, South Australia, Queensland, and Western Australia, those of Tasmania being in the hands of a general manager, under the control of the State Minister for Lands and Works. Proposals for constructing a line from Adelaide, in South Australia, across the continent, to Port Darwin, in the extreme north, and from Adelaide to Western Australia, are under consideration. The latter line, if completed, would enable an almost unbroken journey from Brisbane, by way of Sydney, Melbourne, and Adelaide, to Western Australia, to become accomplished, but the gauges of the different States would have first to be made uniform. The total cost of construction and equipment of the various Government lines to June 30, 1904, was £131,930,764; the gross earnings in 1903-4 being £11,193,518, and the net earnings £4,065,631, thus producing a fair rate of interest on the amount of capital invested. The net earnings would have been considerably larger had the lines through several of the less populated districts been of a "pioneer" character. The greater portion of the railways are substantially built, and will endure for generations. In places engineering difficulties of considerable magnitude have been successfully overcome, especially in New South Wales, where the great cantilever bridge across the Hawkesbury is one of the largest and finest in existence. Compared with certain sparsely settled countries, the cost of railway construction in the Commonwealth has been remarkably low, being £9,890 per mile, as against £14,355 in Brazil, £12,810 in the United States, £12,067 in Canada, £10,363 in Cape Colony, £10,213 in the Argentine, £10,103 in Chili, and £9,417 in Mexico. At the same time the work has been of a more solid and durable character than in several of the countries mentioned. Considering the limited number of population, the Commonwealth railways are proportionately amongst the best-paying lines in the world, the average net revenue per train mile being 21·6d., against 25·0d. in the United Kingdom, 17·7d. in Belgium, and 29·5d. in the United States. The number of passengers carried in 1903-4 was 110,163,232, while the goods traffic showed a total of 14,985,106 tons. The rolling stock included 2,191 engines, 3,921 passenger carriages, and 41,918 goods trucks. In New South Wales the railways are divided into three systems, the south, running from Sydney across the Murray to Melbourne; west, from Sydney to Bourke; and north, from Sydney to Brisbane. In Victoria the lines form seven distinct groups, covering the State with a complete network of lines. In Queensland the railways constitute a number of separate systems, three of which have Brisbane for their centre, while others run inland from each of the principal ports. In South Australia the railways are divided into three systems, radiating from Adelaide, with the exception of a short line in the northern territory; in Western Australia the railways comprise five systems, connecting the larger centres of population; while in Tasmania, Hobart, Launceston, and other places are similarly linked together. These figures will afford some idea of what the federated States have done with the greater portion of their borrowed capital. They may have been somewhat hasty at times, but they have ample assets in the shape of their railways alone to meet all their obligations. The only fault that can be found with the State policy of the past, according to the New South Wales Government Statistician, "is that in some cases expensive lines have been laid down in empty conutry, the requirements of which could have been effectually met for many years to come by light and

* Communicated by Mr. John Plummer, Sydney.

cheap lines.'' Had this been done the net profits of the Commonwealth railways would have been largely increased.

CORRESPONDENCE.

THE PATENT LAWS.

The paper read before the Society on the Patent Laws and published in the *Journal* on the 16th Dec., will be much appreciated, especially by those interested in inventions and patents. Its appearance also is opportune. As a rule, inventors will not trouble to obtain a copy of the new Act of 1902, they naturally expect their patent agents to be thoroughly conversant with it, but when the information is picked up in the form as given out by the paper and the discussion, the knowledge is found to be very useful to the inventor. The writer and his father (the late Sydney Smith) have obtained for their inventions many patents, both British and foreign; the difficulty met by others in getting their claims through the German and United States Patent Offices have been felt by them. Some of the objections raised have been most frivolous, and the loss of time involved in amending and appealing serious, notwithstanding the applications being in the hands of able and experienced patent agents. Our firm considers the new Patent Act an improvement on the old. In the light of experience the Act will be best tested, and its value known.

It was a surprise that no one present at the meeting said a word or two in reply to the Chairman's remarks when he said, "It was easy to invent, there was nothing in that, but it was extremely difficult to introduce a new manufacture, and the people who did introduce new manufactures ought to be the people who were rewarded."

Those who have come in contact with inventors know that a majority of them are not pushing, enterprising, business men. That is not their sphere of work, that is not their forte.

It is unreasonable to expect an inventor who has spent large sums of money in experimental work, and sometimes years in brain labour, should at the same time possess business qualification for putting his invention on the market. In some instances this has been done; the cases are rare. A man may become a clever business man by training, but you cannot make an inventor by any such process. The faculty is born with him, sometimes hereditary, and in the science of machinery generally found in the mind of the practical mechanic. The factor that developes and exercises it most is necessity, which still remains the "mother of invention." The reward of a valuable and useful invention often goes to the keen, energetic, business people, while the obscure genius "'who gave it birth" receives but scant recognition or adequate remuneration, unless he be connected with a firm possessing the necessary capabilities for making the best of his patented invention. Instead of the prosperity of this country being principally attributed to the policy of free trade there is a deep and growing conviction in the country that much of the progress made belongs to that distinguished class named by Mr. Abel, and who by their successful inventions created industries and made England, at one time the workshop of the world.

ISAAC SMITH.
(Of Sydney Smith and Sons.)

Basford Brass Works, Nottingham.

OBITUARY.

FREDERICK ELKINGTON.—Mr. Elkington, who had been a member of the Society of Arts since 1859, died at his residence, Sion Hill, near Kidderminster, on Monday, 2nd inst., at the age of 78. He was the eldest son of Mr. George Richards Elkington, the patentee of electro-plating, and he was largely responsible for the development of the important firm bearing his name. He was made a Chevalier of the Legion of Honour in 1852, and on the occasion of the Paris Exhibition of 1885 he was promoted to be an officer of the Legion. In 1878 he served the office of High Sheriff of the County of Worcester and was a governor of the Imperial Institute. He was greatly interested in the Volunteer movement in Birmingham, and one of the first to join the force. A carriage accident, however, necessitated his retirement some years ago, when he was promoted to the rank of major. Apart from his commercial career, he rendered valuable service to art, and was an industrious and discriminating collector of Japanese and Chinese enamels.

GENERAL NOTES.

BRITISH GUIANA AND COTTON.—The annual report of the Department of Mines and Lands for the year ended March last comments on the comparative failure of the proposed revival of the cotton industry in the colony. The Berbice Cotton Growers' Association has been trying to interest the peasantry in the industry, but in spite of generous offers of assistance little has been done. At the date of the report only about four acres were in cultivation in cotton by peasant farmers. Nor is the outlook more promising, for, although there was money available for an exhibition in the present autumn, there were no exhibitors. Several of the plantations in Berbice are, at the request of the Association, giving cotton growing a fair trial, but the attempts must be regarded, says the

report, more in the light of practical object-lessons for the encouragement of the small farmers than indications of any serious idea on the part of the sugar planter to establish cotton growing as a complementary industry. Just now the prospects of the sugar industry are so bright that the planter will rather use every effort to put all available land in canes than detach labour to cultivate the pasture lands of his plantation with cotton. Moreover, the growth of the rice industry tends more and more to shorten the supply of labour.

IMPORTS AND EXPORTS.—The following figures are taken from a Table prepared by the Board of Trade, and showing the principal imports and exports of merchandise of the principal countries for which the particulars can be given up to September 30, 1904, inclusive, and referring in all cases to the same period, namely, the nine months ended September. The corresponding figures for 1902 and 1903 are added for the purpose of comparison:—

Imports (see Note that follows Tables).

	1902.	1903.	1904.
	£	£	£
United Kingdom	339,522,000	341,688,000	345,358,000
France	129,965,000	140,551,000	132,455,000
Germany	207,677,000	220,378,000	227,887,009
United States	146,281,000	150,083,000	156,537,000
British Indies	30,677,000	39,706,000	45,843,000
Japan	19,696,000	24,858,000	26,810,000

Value of *principal* articles only.

Exports (Domestic) see Note that follows Tables.

	1902.	1903.	1904.
	£	£	£
United Kingdom	209,501,000	217,379,000	221,189,000
France	124,021,010	125,219,000	127,561,000
Germany	171,262,000	184,161,000	187,424,000
United States	192,230,000	201,635,000	201,132,000
British India	62,795,000	71,860,000	77,899,000
Japan	17,863,000	20,810,000	22,133,000

Value of *principal* articles only.

The Board of Trade explains that in the case of the United Kingdom, France, Germany, and Japan the import figures represent imports for home consumption only, *i.e.*, excluding the re-exports. In all cases the export figures are intended to represent exports of domestic produce. In most cases, however, they include a certain amount of goods originally imported for consumption, and which, if dutiable, have been charged with duty, but which are subsequently re-exported. It will be noticed that Germany heads the list in absolute increase in exports, but British India comes in a very good second—£16,162,000 as against £15,104,000. The United Kingdom is third on the list with an increase of £11,688,000. Up to the date to which the figures carry the war had not affected the steady increase in Japan's exports.

THE CITY AND THE BOARD OF TRADE.—In July, 1897, the Board of Trade appointed a committee to consider and advise as to the best means of bringing to the knowledge of traders in this country the information furnished by consuls, commercial attachés, representatives of the colonies, and other officers, as to the supply and demand, and the conditions of the markets in their respective districts, and to report how far arrangements could be made for the exhibition of trade samples in London and in provincial trade centres. A year later, in July, 1898, the committee reported, and one of their principal suggestions was the creation of a Commercial Intelligence Branch of the Board of Trade. This suggestion was adopted and the branch opened in October, 1899. With a view to ensuring that the new branch shall be kept as far as possible in touch with all those interested in its efficiency, and in order to obtain advice of the widest possible scope upon questions of commercial interest, a consultative advisory committee was appointed in May, 1900. Four years later, in March, 1904, this committee reported upon its work and was able to show that the Intelligence Department was steadily growing in usefulness to the business community. In 1901 the applications for information numbered 1,614, in 1903 they had risen to 3,599. But the offices of the intelligence branch were at the West-end, and it is difficult to get the ordinary man to go far in search of information, so it was determined to move from 50, Parliament-street, to 73, Basinghall-street. This change to the centre of the City took place some months ago, and has now been tested sufficiently long to enable it to be said that it promises to be highly successful, there being already a sensible increase in the number of inquiries. The department cannot fail in its new habitation to be of great use to merchants' and traders' associations in search of accurate information on commercial matters in the interests of British trade.

EDUCATION IN THE STRAITS SETTLEMENTS.—Sir John Anderson's annual report for 1903, as Governor of the Straits Settlements, issued a week or two ago by the Colonial Office, contains some remarks concerning educational progress. Nearly all the schools in the colony are vernacular schools for Malays, under the direct control of the Government by whom all the expenses are defrayed. Free tuition in Malay is thus given to some 10,000 pupils. The remaining schools are, with the exception of two or three, which are controlled and financed directly by the Government, aided schools, managed by private bodies receiving Government grants in aid. In 2 schools only English is taught, in 5 English and Tamil, in 3 Tamil only, in 1 Chinese only, and 171 Malay only. The net Government expenditure

on aided schools (English, Anglo-Tamil, Tamil, and Chinese) was 53,087 dols., and on Government vernacular schools 75,128 dols. The sum of 12,376 dols. was also spent on the Malacca Training College for Malay teachers. The demand is in excess of the supply, and it will be some years before the vernacular schools are staffed exclusively with trained teachers. A training school for English teachers is still under contemplation. The principal English schools now have classes in commercial subjects.

THE ST. LOUIS EXHIBITION.—Although the stockholders will get nothing in the way of dividends, the receipts of the Louisana Purchase Exposition have been immense. No official final statement has yet been issued, but the following is a summary from safe sources of the receipts:—

	Dollars.
St. Louis city (free grant)	5,000,000
U.S. Congress (free grant)	5,000,000
St. Louis citizens (subscriptions)	5,000,000
U.S. Congress for exhibit......	1,488,000
Insular Government (Phillipine Islands)	500,000
State appropriations	6,000,000
Gate receipts (estimate)........	5,000,000
Concessions (25 per cent.)......	1,500,000
Foreign Governments	5,000,000
Value of exhibits (estimate) ..	11,000,000
	46,488,000

It is estimated that there were 5 000,000 visitors to the city during the exhibition. Suppose they averaged 15 dols. each spent in the city—a moderate estimate—that would mean that 75,000,000 dols. were circulated by the visitors during the seven months of the exhibition.

THE COTTON SUPPLY.—No one has been more identified with the movement of which the British Cotton-Growing Association is the outcome, than Sir Alfred Jones, and it is re-assuring to find him saying in a letter to *The Times* that the American bumper cotton crop for the current year will not check the efforts now being made to increase the supplies of cotton from within the Empire. He protests against the idea that "a big crop and 4d. will be the end of the British Cotton-Growing Association." American opinion seems to agree with him that the movement has now gone so far that it cannot be seriously affected by one big crop in the South, whatever might be the result of a succession of them. The present cotton crop of over 13,000,000 bales is the largest on record, and for the moment Lancashire has nothing to fear, but just as the home demand is shrinking the wheat exports of America, so the time may not be very distant when most of the raw cotton of the union will be worked up in American mills. By that time it is to be hoped the British requirements may be met by supplies from British territory, that the West Indies, the West Coast of Africa, the Sudan and Central Africa, India and Guiana may between them meet the deficiency. It is curious that of the estimated increased exports of cotton from America since September—about 400,000 bales—the Continent has taken less by 10,000 bales than during the like period of 1903. Nearly the whole of the increased export has come to England.

CHINESE AND INDIAN IMMIGRATION INTO THE STRAITS SETTLEMENTS.—The population of this Far Eastern possession is increasing rapidly by reason of immigration from China. These immigrants find a ready employment in tin-mining, and are really necessary to the successful development of the Malay Peninsula generally. Some rise to the position of contractors to the Public Works Department, others enter Government service, and make their way to high positions in the audit and other departments. The following are the figures of the Chinese immigration for the last four years:—

Year.	Male.	Female.	Total.
1900.........	188,985	11,982	200,947
1901.........	166,956	11,822	178,778
1902.........	194,005	13,151	207,156
1903.........	205,782	14,539	220,321

On the other hand, the total number of immigrants from British India was as follows:—1901, 28,259; 1902, 20,242; 1903, 22,033. Scarcity in India is evidently a dominant factor so far as the emigration of the Tamil coolie is concerned. While the Chinaman flourishes as a merchant, and drives about Singapore or Kwala Lumpur in a motor-car, the Tamil (who, according to officials in the Public Works Department, is deficient in stamina) makes his way back to Southern India as soon as his means permit.

THE WORLD'S MERCANTILE MARINE.—Recent statistics estimate the total tonnage of the world's merchant marine at 33,643,000 tons, and the number of vessels at 24,850, of which 12,671 are steamships with 27,184,000 tons, and 12,182 are sailing vessels with 6,459,000 tons. This gives an average of about 1,540 tons for steamers and 538 tons for sailing vessels. Although the construction of large ships has greatly developed during late years the greater part of the world's goods is still carried by vessels of average tonnage. The number of ships of over 10,000 tons is only 89. Of vessels over 5,000 tons the United Kingdom has 533, Germany 100, America 48, France 36, Russia 12, Japan 16, and the Netherlands 7. The tonnage of the principal countries is as follows:—United Kingdom, 16,006,374; America, 3,671,956; Germany, 3,283,247; Norway, 1,653,740; France, 1,622,016; Italy, 1,180,335; Russia, 809,648; Spain, 714,447; Japan, 726,818; Sweden, 721,116; Netherlands, 658,845; Denmark, 581,247; Austria-Hungary, 578,697; Greece, 378,199; Belgium, 157,047; Brazil, 155,086; Turkey, 154,494; Chile, 103,758; Portugal, 101,404; and Argentina, 95,780 tons.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 18.—"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES. SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., will preside.

JANUARY 25.—"London Electric Railways." By the HON. ROBERT P. PORTER.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 19.—"The Gates of Tibet." By DOUGLAS W. FRESHFIELD. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

JANUARY 24.—"British Commercial Prospects in the Far East." By BYRON BRENAN, C.M.G., late H.B.M. Consul-General at Shanghai. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILY HEWITT. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic, and Fountain Pens." Three Lectures.

LECTURE I.—JANUARY 23.—*Ancient Writing Implements.*—The Stylus and Tabula—Calamus or reed pen—Stencil—Quills, quill nibs, attempts to make quills more serviceable—Substitutes for quills—Silver pens—Ink horn and penner—Ancient writing outfit—Eastern writing implements—Survival of ink horn—Japanese writing box and pens—Their portable writing set—Early metal pens—Steel pens—Barrel pens—First patent for metallic pens—Improvements in steel pens with the object of increasing their ink-holding capacity — Reservoir nibs, various illustrations.

LECTURE II.—JANUARY 30.—*Stylographic Pens.*—Rudimentary forms—Early patents—Rigid points, needle points—Various writing or marking pens—Modern Stylographic pens, Nota Bene, Cygnet, and others—Gold pens, description of manufacture.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements — Self-filling reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

JUVENILE LECTURES.

Wednesday afternoons, January 4 and 11, 1905, at Five o'clock, CARMICHAEL THOMAS, "The Production of an Illustrated Newspaper." (Two Lectures.)

LECTURE II.—JANUARY 11. — Compositors at work—Preparation of stereos—Manufacture of paper—The printing office—Folding and stitching machines—Colour printing—Importance of good titles—The editor's waste-paper basket—Curious sketches: the Russian censor—Foreign illustrated newspapers.

The lecture will be fully illustrated by lantern slides. An exhibition of drawings will be shown on the walls.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 9...Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. Walter F. Reid, "Some Chemical Aspects of the St. Louis Exhibition."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 4 p.m. Mr. H. Hill, "Studies in Spider Life."

TUESDAY, JAN. 10...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Sir William Henry White, "The Recent Visit to the United States and Canada."

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, JAN. 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 5 p.m. (Juvenile Lectures.) Mr. Carmichael Thomas, "The Production of an Illustrated Newspaper." (Lecture II.)

Biblical Archæology, 37, Great Russell-street, 4½ p.m. Annual Meeting.

Japan Society, 20, Hanover-square, W., 8½ p.m. "Japanese Under-Graduates at Cambridge University."

Royal Literary Fund, 7, Adelphi-terrace, W.C. 3 p.m.

Civil Engineers, 25, Great George-street, S.W. 3½ p.m. Sir William Henry White, "The recent visit to the United States and Canada." (Repetition of lecture.)

THURSDAY, JAN. 12...Antiquaries, Burlington-house, W., 8½ p.m.

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on paper by Mr. W. P. Adams, "The Combination of Dust Destructors and Electricity Works Economically Considered." 2. Messrs. Wm. H. Booth and J. B. C. Kershaw, "Fuel Economy in Steam Power Plants."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, JAN. 13...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. James Swinburne, "Theory of Electricity and Magnetism."

Astronomical, Burlington-house, W., 8 p.m.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 18, 8 p.m. (Ordinary Meeting.) CAPTAIN LIONEL JAMES, "Wireless Telegraphy and War Correspondence."

THURSDAY, JANUARY 19, 4.30 p.m. (Indian Section.) DOUGLAS W. FRESHFIELD, "The Gates of Tibet."

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

JUVENILE LECTURES.

On Wednesday afternoon, January 11th, Mr. CARMICHAEL THOMAS delivered the second and last lecture of his course of Juvenile lectures on "The Production of an Illustrated Newspaper."

Mr. Thomas continued the history of the sketch which in his first lecture he had brought to the point of being photographed and made into a plate suitable for printing, through its further process of multiplication and preparation in the foundry and machine room. In some cases the drawing stood alone on a page of the periodical in which it was printed. More often it was accompanied by letterpress, the process of setting up which in type was described. The completed page of letterpress and illustrations was called a "forme." These "plates" or "formes" it was necessary to multiply, seeing that the whole issue of a newspaper could not practically be printed from a single set. First of all type and picture plate were locked together, and then were ready either to print from or to furnish duplicates. The preliminary step to obtaining the duplicate was to take an impression of the whole forme in plaster of paris, which was done by spreading the plaster over a sheet of stout paper, laying the paper very carefully down on the forme and subjecting it to such heavy hydraulic pressure that the plaster of paris sank into every line and scratch of the plate. The resulting impression was called the "mould," and it was next made dry and firm by baking. Thereafter metal "casts" could be taken from it, and for that purpose the mould was placed in an iron casting-box, into which molten metal was then poured and allowed to cool. The "cast" emerged therefrom identical in surface and appearance with the original plate. It had, however, to be "routed" by a revolving chisel, called the "router," which grooved out unnecessary portions of the metal. The back was smoothed by a second machine, and the cast was subjected to various processes in order to make it clean, neat, and workmanlike. Last of all it had to be hardened, so that its surface should give clear, strong impressions, and this was done by electrolysis. The plate was dipped into electric baths, by which its surface was coated successively with fine films of copper and nickel.

Having described all these processes and illustrated them by photographs, the lecturer interpolated a brief description of the processes by which grass and wood pulp were converted into paper suitable for printing. First the grass (of which the best variety was esparto grass) was "winnowed," cleaned, or separated. It then proceeded to the boilers and was made into pulp, which was bleached in the receptacle known as the "potcher," and was in succession strained and beaten till it resembled a custard of an exceptional kind. It might then be imagined as being fit for the paper-making machine, into which it went as pulp at one end and came out as paper at the other. In the first stage the pulp spread itself on a wide band of very fine wire netting, which retained the substance of the bulk but drained

off the water; in other stages grit was removed and the pulp was further strained. Air pumps sucked the moisture out of it, rollers hot or heavy or both pressed it and dried it and smoothed it, while at the end of the process, when the paper was about to come out in its solid condition, the final rollers glazed it preparatory to allowing to take its place in the great reels. These reels sometimes contained miles of paper. One that was made by Messrs. Spalding and Hodge, of which Mr. Thomas showed a photograph, weighed several tons, and the paper if unwound would have stretched out for nine miles and a half.

Returning to the progress of the plate, Mr. Thomas described the attachment to the great electrically-driven printing presses, and enumerated the last steps necessary to convert the impressed reels and lengths of paper into illustrated periodicals. When the paper had been printed the sheets were lifted on to trollies, which conveyed them to the warehouse, where they were folded, supplied with covers, and finally stitched by a most ingenious machine devised for the purpose. Last step of all before they were delivered to the newsagents, their edges were neatly cut and they were stacked in appropriate quantities.

But before leaving the description of the mechanical processes in the manufacture of the paper, an account was given of the methods of colour-printing to which were owing the production of the coloured plates that formed so attractive a feature of the Christmas supplements at this time of year. Formerly the reproduction of a coloured picture was a very complicated matter, and good results were usually obtained only by employing a large number of printings, sometimes as many as twenty. But a few years ago a new method of printing in colours, known as the three-colour process, was discovered and elaborated till it caused quite a revolution in the printing world. Every painting, it must be remembered, is composed of three primary colours, yellow, red, and blue. Suppose then we took three negatives, one of which would absorb all the yellow, another all the red, and another all the blue that existed in the picture, and turned these negatives into plates which could be used for printing. If we then printed on a piece of white paper the first plate in yellow ink, and on the top of it the second in red ink, and on the top of both the third in blue ink, the final result would be a composite reproduction which gave a remarkably good idea of the original picture. Having thus described the principle of three-colour printing, Mr. Thomas went on to exhibit some actual negatives and plates, and to show how by carefully superposing them the desired result could be reached. Very careful manipulation was required in the super-position, and the very best and purest light was necessary, in order that no mistakes should be made in the choice of the constituent hues. [The meeting-room was hung with some fine examples of the results obtained by this process of colour printing, and a picture was thrown on the screen showing the works which the *Graphic* has erected at Reading for the special purpose of making colour-prints of the highest class.]

Having set forth in their completeness the mechanical processes which secure the regular output of the weekly and daily illustrated paper, Mr. Thomas turned to the other side of their production, which was the work of the editorial rooms. He referred, first of all, to the demand which gave birth to the supply of newspapers—a demand which was nowadays usually felt most by those who, having been used to regard their newspapers as quite as regular a fact as their breakfasts, were temporarily cut off from them—and he quoted instances of the eagerness of the soldiers during the South African War to obtain newspapers, He also mentioned the curious fact that Sir Harry Johnston, while exploring Central Africa, had sometimes found a parcel of *Graphic* supplements of the greatest value in inducing African monarchs to come to terms. If, however, the demand for newspapers was great, some of the "materials" of supply were curious. The oddest apologies for drawings were sometimes sent in to editors, as some of his slides showed, and sometimes the oddest requests were made. One of the most curious sketches that had ever been sent to the *Graphic* was forwarded by a large employer of labour in the colony of Mahe on behalf of a released slave. These sketches were made by Billy King, and depicted his experiences from the time he was captured by the Arab raiders down to the time of his release by a British gunboat. They were published, as he now showed them, in facsimile, but not the least interesting part of them were their appended descriptions. These ran as follows:—

"The Arab often go out travelling in the mountain to get slaves—if one intempt to run they fire the gun with them.".

"When they had gather so many they carried all

down home. See they tight their hands; the little one as well and woman too."

"And at night when they sleeps, all the wood are tight up to the cross bar; one man always go up to tight the end."

"All the slaves are unlanding (unloading) and ready to be received on board."

"Now the rober are caught, they shout her once to start with, but they wouldn't stop; some time fire again and burn their sails till they get near."

"After having all out they put slave afar off, and light it with fire and burn it and ship go her way to Seychelles."

Mr. Thomas concluded his lecture by some references to the uses and misuses of illustrated journalism. One form of misuse was that inflicted on them by the Russian censor, who in one instance blotted out a *Graphic* picture, or photograph, in which the Czarewitch was shown hunting with the Nizam while in India. A good deal of speculation was hazarded on the reasons for the censor's action, and it was at last concluded that he objected to some words of the description printed underneath, which ran, "Unfortunately the Czarewitch did not get a shot." The censor must have thought it meant "Unfortunately the Czarewitch did not get shot." Another misuse of illustration was of a different kind, and it was that of which the Germans were guilty during the Boer War when they published as authentic drawings which purported to show British soldiers firing from behind women. An instance was given of the use of an illustrated paper in a very different and quite legitimate way. In March, 1895, during the Chino-Japanese War, the *Daily Graphic* published an illustration showing the attack on Wei-hai-wei by the Japanese. In the middle distance were the Japanese ships; in the foreground were three British ships, *Spartan*, *Edgar*, and *Centurion*. Away off to the right was a little ship, under which were the words "German flagship. Under sail only." This picture, coming into the hands of the German Emperor, furnished him with a striking object-lesson with which to support his scheme of German naval expansion. He had a copy of the picture placed on the seat of every member of the Reichstag on the day when the naval vote came on. On each copy was written, "Welch ein Hohn liegt darin," which translated meant, "What a mockery this is." The naval vote was passed.

The CHAIRMAN (Sir William Preece, K.C.B., F.R.S.), proposed a hearty vote of thanks to Mr. Carmichael Thomas for his interesting course of lectures, which was carried unanimously.

CANTOR LECTURES.

MUSICAL WIND INSTRUMENTS.

By D. J. BLAIKLEY.

Lecture IV.—Delivered December 19, 1904.

FLUTES.

It was noticed during the last lecture that many ancient Greek instruments, commonly referred to as flutes in our translations, were really reed instruments, and these, therefore, do not come into the category of flutes as we understand them. That tubes either of reed or of other material blown across the end were used in ancient days is, however, unquestionable; the tube of the common Pandean pipe and the ancient Egyptian Này now before you are instances.

The evidence of anything beyond this as concerns flutes blown directly from the lips is unreliable, but it is probable that the Greeks used a whistle flute, blown from the side by means of a mouth tube, and this may have been confused with the true flute as the name is now understood, or the Flûte Traversière.

The name flute in its broadest modern sense signifies an instrument in which a direct stream or blade of air, unassisted by a reed or any other contrivance, is the immediate cause of the vibration of the air-column.

Such a stream of air directed either down a tube, across an open end, or across a lateral hole, cut in some parts of its length, does not of necessity cause vibration. This result, vibration, depends upon the fluctuation of an induced current. In their detail the conditions upon which such vibrations depend are perhaps not yet thoroughly worked out, but some indications of the action of the air-reed or blast causing induced currents can be given.

The bird-call, or fowler's whistle, is a small hollow chamber of bone or ivory, with an inlet and outlet through which air can be blown from the mouth. The jet of air from the mouth in passing through the chamber carries with it a portion of the air in the cavity, thereby reducing the density of the remainder until, at a certain point, a re-action takes place. It is the rate of variation of density caused by the direct current which determines the pitch of the note.

Another example of an induced current was to be seen in the brazier's gas blow-pipe, the small lighting jet attached to the main gas tube travelling, when the air-jet only is turned on, in a direction contrary to that of the air current.

[This action was shown by direct experiment, but cannot well be described without the apparatus.]

These experiments, and others of similar character show that a stream or blade of air issuing steadily from an orifice such as may be formed by the lips, can, under certain conditions excite an alternating change of density in the air in its neighbourhood. It is this change of density which occasions the vibration causing the sensation of musical sound. The air-reed, in whatever way produced, may be regarded as an ultimate refinement of the reed made of solid elastic material which was considered in the last lecture.

The means adopted in the course of flute-making for the formation of this vibrating blade or lamina of air have been two. The first is by the passing of air from the mouth through a slit as in the common whistle, the blade thus formed passing across an orifice, and just grazing the lip on the opposite side. Flutes made on this scheme have now passed away, with the single exception of the flageolet, but as they illustrate a principle and have a distinct historical interest, I will show some on the screen. The lantern slide is taken from Kappey's "History of Military Music," and the instruments themselves are in the museum of the Royal Conservatoire of Music at Brussels. A whole group of recorders is here shown, the large bass instruments being furnished with a crook or bent tube to convey the wind to the whistle part of the instrument. In all of them the typical six finger-holes are seen, and in the larger instruments some extension of the compass downwards is provided for by key-work.

One of the instruments of this family was the pipe used with the tabor. This instrument had two finger-holes and one thumb-hole only, but as the first octave was not used, the three holes sufficed to give the *d*, *e*, and *f*, required to complete the scale between *c* and *g*, the second and third proper tones, and also the other notes lying between the higher harmonics.

With this slight account of the recorders or whistle-blown type of flute, we must pass on to those which have more interest at the present day, and are "flutes" strictly speaking, as we now understand the term. All these depend for speech upon the action of a stream of air issuing directly from the lips without the intervention of a whistle mouthpiece of any kind. This flute is probably not more than 500 years old, and in its simplest form is a cylindrical tube with a mouth-hole bored near one end, and with a plug or cork inserted a little beyond the mouth-hole. Such a tube corresponds in length to a half wave-length of its lowest note, and is capable, by over-blowing, of giving the octave, twelfth, &c., or notes in the harmonic series.

The oldest known instrument of this kind is the Schweizerpfeiff or Zwergpfeiff (Swiss-pipe or Dwarf-pipe), a flute with the normal six finger-holes, and without keys for the semitones.

These cylindrical flutes were poor in tone, and incorrect in tuning in the over-blown octaves. It is manifest that the mouth-hole is not an exact equivalent of the open end, and this divergence causes departures from the normal law of vibration in cylindrical tubes.

The first attempt at correction was by giving a conical form to the greater part of the flute, leaving the head-joint cylindrical. This correction in conjunction with the gradual addition of key-work resulted in the disappearance of the English flute or recorder, in favour of the German or transverse flute, which held the field for about two centuries. Its chief faults were due to the supposed necessity of having holes covered by the fingers instead of by artificial pads wherever practicable.

About the middle of the last century Theobald Boehm, putting into a practical shape ideas that appear to have been at least held by others, produced a flute in which every note speaking through a side-hole was fully vented by holes below it, by which means great equality of tone was gained. He subsequently discarded the plan of covering the holes directly by the fingers, and substituted key-work. He further returned to the original cylindrical form of the flute, and obtained correct intonation in the octaves by giving a curved conoidal form to the interior of the head joint. These alterations entailed a modification of the established fingering, but Boehm's principle has made great way, and now practially holds the field.

As one example of conditions bearing upon a point admittedly somewhat obscure, we may consider the influence of that part of the flute lying between the mouth-hole and the cork-stopper. It is certain that the tone quality is much influenced by the proportions of this space, and in all probability a subsidiary vibration of a high note of constant or nearly constant pitch is here set up. This note, being blended as a partial with the general

tone of the instrument, gives a distinct colouring, to which is due the sense of unity of quality, and also of individuality, running through the whole compass of the instrument.

We may take an illustration from another organ of sense than the ear—the eye. We may see a landscape with its distinctive greens, browns, purples, and other colours under ordinary light, and yet the general effect may be greatly modified either by a grey sky, or by the rays of a setting sun. So with sound. We may have groups or a succession of very distinct wave-forms, but these are capable of modification by the introduction of another wave-form which shall be common to all.

This view which I put forward tentatively does not apply only to the flute, for analogous conditions are to be found in brass and other wind instruments.

The attempt to summarise the chief points in the developments of wind instruments leads to the following conclusions as regards the different classes.

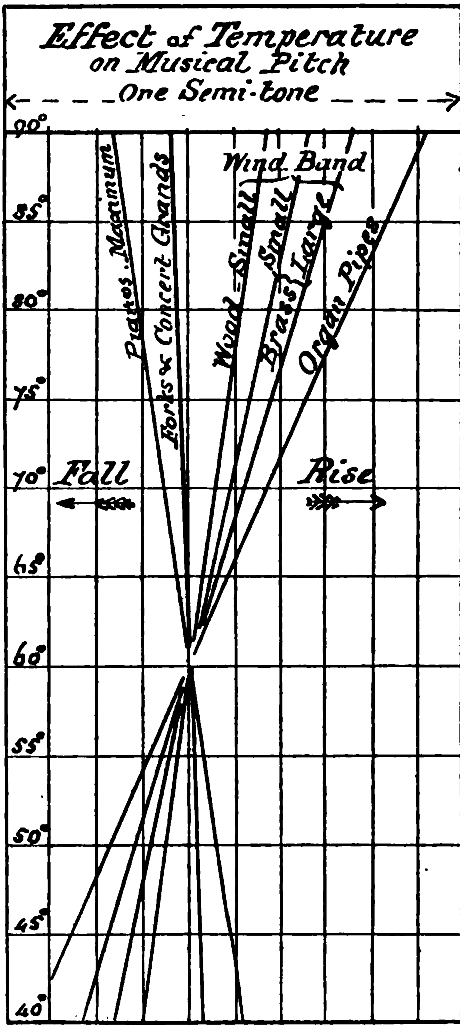
Brass Instruments.—The direct action of the lips as applied to the most simple horns has been maintained throughout all improvements and modifications.

Reed Instruments. — Reeds enclosed in chambers, and therefore not under the direct control of the lips, have passed away so far as artistic music is concerned.

Flutes.—A similar result is to be observed. The air-reed issuing from a mechanically formed slit, as in the recorders and other beaked flutes, has passed away.

We find, then, that all attempts to improve upon the wonderfully sensitive action of the lips by mechanical means have disappeared, but the work which lies fairly within the province of design and mechanism, that is to say, the determination of the proportions of a tube to give particular intervals and tone-quality, and the instantaneous regulation of its length in accordance with the requirements of the musical scale, so that it shall be suited in every way for response to the impulse of the lips, has been very marked during the last century.

Temperature is one natural condition which has an effect, in greater or less degree, upon all instruments; and although the full consideration of its influence would take more time than is at our disposal, a brief reference to it will not be out of place. Change of temperature affects the pitch of all instruments, and if all groups were influenced in the same direction and to the same extent, the result, in practical music, would be small, for all instruments would rise or fall together. The effect of heat upon metals being to expand them, a tuning fork is rather longer when warm than when cold, and is consequently flatter in pitch. If the expansion of the metal were the only effect of heat upon a brass



instrument, the same result would follow; but another influence is at work, producing five or six times the effect in the contrary direction. This influence is the greater velocity of sound in warm than in cold air. The change of pitch corresponding to this increased velocity is equal to a rise of a quarter of a tone between 47° and 73° Fah., a very ordinary range of temperature. This change is exhibited to its full extent in organ flue-pipes: the reed pipes

are affected in varying degree. All the wind instruments we have been considering in these lectures are when in use more or less warmed by the breath, and this prevents the external changes of temperature having the full effect they otherwise would have. In the diagram a range of temperature is shown from 40° to 90° Fah., and a range of pitch of one semi-tone divided into tenths. At 60° the various instruments are assumed to agree in pitch, and their different rates of departure from unison is shown by the positions of the various thick slant lines.

The lecture was illustrated by lantern slides and experiments, and also by the following musical illustrations :—

Flute solos, Chant Pastorale, Mazurka, *Andersen*, Mr. H. Warner Hollis. Horn solo, Romanza, *Karl Maty*, Mr. T. Busby. Concertstück, *Rietz*, flute, oboe, clarinet, horn, bassoon, and pianoforte, Messrs. Hollis, Fonteyne, Gomez, James, and Busby. Pianoforte, Mr. R. H. Walthew.

BUILDING BYE-LAWS AND RURAL DEPOPULATION.

There is general agreement that the question of rural housing is of great and pressing importance. It is so because it is intimately associated with the problem of rural depopulation. The higher wages offered in towns, the greater freedom, the more varied life, the fuller opportunities, all these considerations appeal to the young and ardent, and conduce to the depopulation of the country side. But none has greater weight with the young villager than the absence of house accommodation. The agricultural labourer marries young. At an early age he can command the highest wages open to his class. The prudential considerations which weigh with others and retard marriage do not affect him. But whilst the choice of a wife may be easy oftener than not he can find no house suitable to his wants. The cottages in the village are all occupied and no new ones are built. Even the old ones as they crumble away are not replaced. Single, the village youth can either live at home or in lodgings, married he must migrate for there is no cottage vacant. And this knowledge quickens the exodus to towns which is such a deplorable feature of our times. Nor is it likely that the emptying of the country-side will be checked until the rural cottage problem is solved.

It seems strange at first sight that there should be any such problem to be solved. Statesman, landowner, farmer, all are anxious to keep the labourer on the land. Why then refuse to house him properly? The answer is that under present conditions cottages cannot be built at a cost that will give a reasonable, or, in many cases, any return upon the capital invested. An agricultural labourer cannot afford to pay more than 3s. a week for a cottage; indeed, assuming constant employment, and an average of 15s. a week, this rent charge may be thought excessive, and many agricultural labourers are less favourably placed. Three shillings a week means roughly £8 a year. Now, under present conditions, a cottage in the country with a garden costs, exclusive of the land on which it is built, at least £250. Deduct from the £8 £1 for rates, and another £1 for insurance and repairs, and without reckoning anything for depreciation and management, the net return per annum is only £6 upon an outlay of £250, or less than 2 per cent. If cottages are to be put up by landowners generally in sufficient numbers to meet rural requirements, they must not cost more than £150 each. Hence the present search for the means by which such houses can be provided.

This question of construction of labourers cottages has been frequently discussed in the pages of the *Journal*, and as far back as 1863 two prizes of £25 each were placed in the hands of the Council of the Society of Arts, by Mr. J. Bailey Denton, to which was added the Society's medal, to be offered for the most approved designs for cottages with three bedrooms in each, to be built singly or in pairs, at a cost not exceeding £100 each. The limit of cost may be particularly noted. In those days it was not a question whether cottages could be built for £150 apiece, or thereabouts. That was taken for granted. Thus in the discussion following upon a paper read by Mr. John Taylor, jun., a well-known architect in his day, at the meeting of the Society on December 10, 1862, Mr. Bailey Denton said, "The average cost at the present moment of cottages with three rooms, with water supply and the necessary fencing, was £260 a pair. He was speaking not merely of his own experience but advisedly from the experience of those who were largely engaged in building. £260 a pair for cottages was too large a cost, and it was an object worthy of the Society, and of the country at large, to endeavour to reduce the expenses from £260 to about £200 a pair." And Mr. Ebenezer Clark, who followed, said that "he held a contract which was now in course of execution for building cottages as low as £225 per pair. . . . The front room was 12 feet by 10 feet, the back room being about the same size, with a washhouse at the back, and containing a capital oven, copper, sink, and dresser, and a good water-closet. There were two good rooms upstairs and a porch in front." True there were only two bedrooms, and nowadays three are thought necessary, but the cost is noticeable. How is it that cottages cannot now be put up for less than £250? The explanation is not to be found in advanced cost of wages and material, but largely in vexatious building bye-laws.

Up to seventy years ago parochial affairs in rural England were managed in each parish by its own vestry. And this at least may be said for the vestries, that in a purely agricultural parish the interests looked

to were purely agricultural ones. Then came the new Poor Law with transference of powers from Vestries to Boards of Guardians, from villagers meeting and debating in the village to men who met in the town. But there was no great change in practice until after 1894. Until that year the rural district consisted of the area of the Poor Law Union, exclusive of any urban district that might be within it, and the Guardians of the Poor were the real sanitary authority. Since 1894 this has been changed. By the Local Government Act of that year the Guardians ceased to be the rural sanitary authority. The Union was preserved as the rural sanitary district with this qualification—that if it extended into more than one county it was divided so that no rural district should extend into more than one county. Rural district councillors are elected for each parish in the rural district, and the rural district council have ceased to be the same body as the guardians, and are now wholly distinct. By a clause in the Public Health Act of 1875 it was declared that the Poor Law districts might, if they so chose, declare themselves through their guardians to be "urban districts," and so acquire powers similar to those exercised in towns. It sometimes happens that in a district otherwise rural there are some centres of population, hardly large enough to be constituted urban districts, which, nevertheless, require the same control as an urban district, and it was considered desirable to take the power to confer upon a rural district council in respect of such a populous area the right to make bye-laws relating to buildings, &c. But it was never intended that such regulations should be made applicable to the whole of the purely agricultural areas included within the rural districts. Unfortunately, this has happened. In 1896, the Local Government Board confirmed orders investing rural councils with urban powers in 163 cases, many of which were applications for bye-laws relating to streets and buildings. In 1897, the number was 117, and so it has gone on until in a large number of rural districts it has become impossible to build cottages except of brick and stone, and subject to other unnecessary restrictions all making for expense. "It is almost incredible, but it is a fact," writes Mr. Read, the honorary secretary and treasurer of that excellent body, the Building Bye-Laws Reform Association, "that a house in London not more than 30 ft. high, and certainly not more than 125,000 cubic feet, being 8 ft. from the nearest road, and 30 ft. from the nearest building, and from the land of any adjoining owner, can be built of almost any material, but in most of the rural districts which have adopted urban bye-laws such a house must be of brick and stone! And almost any rural council that chooses to apply can get these urban powers. For example, in the *West Sussex Gazette*, of October 13 last, may be found the notice of an Order of the Local Government Board investing the rural district of Horsham with all the powers of an Urban District Council under the Public Health Acts. Now what sort of a district is that of Horsham? It has an area of 76,613 acres, a population of 17,381, and 3,840 inhabited houses. Thus the Horsham Rural District, which is to come under urban liabilities, has approximately one house on every twenty acres, and one person on every 4½ acres! It may be asked why the Local Government consents to the use by any such Rural District Council of the powers exercisable by an Urban District Council. The explanation is that the Local Government Board, in the absence of evidence to the contrary, assumes it to be the wish of the ratepayers concerned, but this assumption is a fiction. To take the Horsham case. Probably not one person in a hundred of the 17,000 who are affected by the notice has ever seen it, and of the people who have seen it not one in ten understands that it is the precursor of a code of bye-laws which will be an injury alike to the individual and the community.

It will never be possible to erect cottages in the country which it will pay landowners to build and labourers to live in until every man has the right to put upon his land any building he desires provided only that he does not endanger public health or public safety. In the towns the jerry builder can crowd upon the ground houses in whose construction the bricks used are so bad as to be scarcely fit for the foundation of a garden path, while the other materials he uses and the sanitary work are no better in quality. In the country a landowner desirous of erecting a cottage in his own park, using the best materials, a mile away from his next neighbour, is liable to be called upon to pull it down if it is not in conformity with the bye-laws of the rural authority, however absurd those bye-laws, originally framed for an urban district, so applied, may be. The experiences of Mr. Justice Grantham are within the recollection of all. Not long ago Earl Roberts had a similar difficulty with the rural authority of the district in which his property is situated, though, on the Local Government Board's recommendation, the Council did not proceed to extremities. And so with many others. Mr. Wilfrid Blunt's experience is perhaps as remarkable as any. He gives it in the *Nineteenth Century and Afterwards* for October. Wanting a small dwelling in a hurry Mr. Blunt applied to Humphries, who advised iron, and put him up exactly what he wanted. "It was," says Mr. Blunt, "as snug and sanitary a house as any poor man could wish to inhabit," and it cost £130. The occupants were pleased with it, the neighbours admired it, and even the District Council informed Mr. Blunt that "there appears to be no objection to your proposals except as to thatched roof." The thatch was got rid of and Mr. Blunt thought himself safe. But he did not know his Council. Fresh objections were taken and he sought advice as to what he should do. He was advised to take no notice and trust to the county magistrates inflicting a nominal fine if the District Council took action. This they did, with the result that Mr. Blunt was fined £5, with a continuing penalty of 2s. per

day whilst the cottage stood. The Council could not say there was anything the matter with it. On the contrary, they admitted that "it was a better and healthier building than the Council's bye-laws allowed to a single storied cottage not of brick or stone." That was the unpardonable fault in the eyes of the Council—it was not of brick or stone.

Why insist upon brick and stone? Why exclude wood; or wood and lath and plaster; or wood and iron; or wood and some patent substance, such as "Uralite," or "wire wove" material; or concrete in blocks and slabs? The Local Government Board has, it is said, determined that timber cottages shall not be built, because they are "dangerous structures." Are they more dangerous than thousands of jerry-built houses put up every year in London? And apart from that, can it be reasonably contended that timber cottages are necessarily "dangerous structures?" "Thousands of old wooden cottages," writes the author of "Modern Cottage Architecture," "have served their purposes for centuries all over England, not to mention the excellent eighteenth century Colonial work still standing in America and elsewhere built entirely in wood. . . . If we turn to the New World to-day with all its goahead enterprise, we find that no one in America for ordinary purposes has ever thought of building houses outside the townships of the United States in any other material than timber. . . In Norway and Sweden, of course timber of necessity is universally used for house construction, risky things being done in actual practice there which we should scarcely imitate here. Nevertheless neither of these countries is disproportionately conspicuous for deaths from fire in wooden houses." Of course the timber must be "well seasoned," sound, and practically free from sap, the carpentry must be workmanlike, and the whole structure should stand on a damp proof course over a dwarf wall of brick, concrete, or stone. Concrete has many advantages where a number of cottages are wanted. Lately, six cottages were built in the Clare and Ross method, of concrete and timber, at Colnbrook, with an upper floor, and having two bedrooms, and a smaller one, for £150 each house. Unfortunately the Board of Agriculture follows the Local Government Board in its dislike of wood. Under the auspices of the Board of Agriculture landowners can borrow money for cottage building on very favourable terms, but only if the dwellings are to be of "brick, stone, or other incombustible material." On these the landowner may raise money at 3¼ per cent., spread over 40 years; but if it is desired to build concrete blocks, or wood, or expanded metal and plaster cottages, the Board offers no help. Its contention is that the law gives it an enormous power in allowing it to over-ride mortgages, and that a full security must be obtained for "the remainder man." The argument would be more convincing if the Board did not countenance first charges for twenty years on farm buildings of wood. Nor is the further argument that cottages of other than "brick or stone," are uninsurable to the amount of the rent charge more conclusive. The Norwich Union, established in a region where wood and plaster cottages are well known, will effect such insurances.

The position taken up by the Local Government Board and the Board of Agriculture in favour of "brick or stone," encourages District Councils to insist upon having them, and these authorities are further persuaded to vexatious interference with the building operations of landowners by the knowledge that only in very rare cases will they resist them. It is not necessary here to inquire into the considerations by which District Councils are swayed in declaring themselves "Urban Districts," and applying to the country side building regulations never intended to be put in force outside towns. It is sufficient to say that in very many districts the District Councils stand in the way of cottage building, since their requirements make it impossible for landowners to put up cottages that can be let at a rent that will give anything like a reasonable return upon the capital invested. The Building Bye-laws Reform Association has drafted a Bill, which is now before Mr. Long, to exempt, under certain conditions of isolation, cottages and other buildings from being subject to any building bye-laws except those relating to sanitation, and some such short amending Act would seem to be desirable. But even if the oppressive action of District Councils is checked, and the landowner is given a free hand within the limits indicated, it would be rash to assume that the cottage problem will be solved. As Mr. C. Cochrane puts it, "In the Home Counties, the North of England, the near proximity to towns, and where other industries have been established locally, the £150 cottage will be a great help when there is a real desire to build. But what is to be done to house the fast decreasing population in districts where wages are 13s. a week, or even less, and the old cottages are falling down in ruin and neglect?" Here surely the local authorities might adopt Part III. of the Housing of the Working Classes Act, 1890, and build where necessary a few cottages which shall not lay a burden on the rates, and which can be occupied by the better-off of the village people whose vacated cottages might be used to accommodate those unable to pay high rates. Unfortunately, the pressure of public opinion is often wanting where the need is greatest, and selfish interests are allowed to over-ride the public good.

The proprietors of the *County Gentleman*, at the instance of Mr. J. St. Loe Strachey, are utilising its pages to endeavour to bring about a state of things under which it will not only be possible to erect a £150 cottage, but easy to discover plenty of firms ready and able to erect such a cottage. Under the same auspices there will be next summer a practical exhibition in London that will seek to show by physical examples what can be done in the way of cheap cottages. It is an excellent idea that should be supported by all who are concerned to stay the depopulation of the country-side.

ELECTRICITY FROM WATER-POWER.*

It should be gratifying to our national pride to know that probably the very earliest example of the production of electricity by means of water power on a practical scale, and its transmission to a distance, was the installation put up for the purpose of lighting at Cragside, Northumberland, by the late Lord Armstrong, in the year 1882. This plant, which was still in daily use in 1884, when the author saw it in operation, consisted of a Siemens continuous-current dynamo, which was driven by means of a belt off an 8 horse-power water-turbine operating with a fall of 30 ft., the electricity, which was delivered at 90 volts pressure, being carried by bare overhead wires attached to porcelain insulators on poles to the house, about a mile distant. It is an interesting fact that when the installation was first put to work it was designed to operate with only a single wire, connection being made to the hydraulic power pipes at the one end and to the ordinary household water-pipes at the other, the earth being expected to form a sufficient return in the manner employed in telegraphy. This plan, which was adopted on the advice of the late Sir William Siemens, was found to be quite ineffective, as, owing to the low voltage employed and the exceedingly rocky nature of the ground, no useful amount of electricity could be transmitted, until the earth return was done away with, and a second metallic conductor substituted.

Though this 22-year-old English example of electricity developed by water-power and transmitted to a distance was, as already mentioned, probably the first such installation in existence in the world, the great development of such installations has, up to recently, taken place almost exclusively abroad. No doubt, up and down this country a very considerable number of small electric plants operated by water-power have been put for private house lighting and such like purposes, and there are even towns—such as, for instance, Salisbury and Keswick—where water-power has for long been employed to assist steam-power for electrical production for public and private lighting, the water-power being in these instances found of great value for the purpose more especially of maintaining the supply during the periods of minimum load. A few hundred horse-power will, however, probably cover the whole of the plants of this character at present running in Great Britain, which is an altogether insignificant amount compared with the much larger corresponding figures for the continents of Europe, America, and other countries.

To obtain accurate statistics as to the amount of water horse-power at present employed for electrical production throughout the whole world is a very difficult matter, as in many countries no figures are available, while in others such as are obtainable are not up-to-date.

* Paper read by A. A. Campbell Swinton before the British Association at Cambridge.

The following Table, giving an aggregate horse-power of nearly one and a half millions, comprises all the hydraulic electricity works of which the author has been able to obtain particulars. He has, however, no doubt that there must be many others in existence to which he has not been able to find any reference; while again, in the case of a number of the installations which have been included, the horse-power now employed is greater than that in use at the time that the statistics were made out.

WATER-POWER ELECTRICITY INSTALLATIONS.

	Horse-power.
United States of America	527,467
Canada	228,225
Mexico	18,470
Venezuela	1,200
Brazil	800
Japan	3,450
Switzerland	133,302
France	161,343
Germany	81,077
Austria	16,000
Sweden	71,000
Russia	10,000
Italy	210,000
India	7,050
South Africa	2,100
Great Britain	11,906
Total horse-power	1,483,390

It, therefore, seems reasonable to suppose that the total amount of water-power actually used for electrical production throughout the world at the present time must exceed 2,000,000 horse-power, which is about double the total steam power at present devoted in Great Britain and Ireland to the same purpose.

It is interesting to calculate what would be the amount of coal required to produce this large amount of horse-power were it generated by steam-engines in the ordinary way. In other words, what is the saving of coal that the adoption of this amount of hydraulic power entails. Many of the hydraulic plants, particularly those which are used for chemical processes, operate at full power continuously night and day, but others work for shorter hours. Assuming, however, that the whole 2,000,000 horse-power is in use for 12 hours per diem—in other words, is employed on the average with what engineers call a 50 per cent. load factor—and assuming, as is reasonable, that were the energy produced by means of coal, at least 3 lb. of this fuel would be required on the average per horse-power hour, we get 5·86 tons of coal per horse-power year, or 11,720,000 tons of coal saved annually on account of the two million water horse-power utilised. Though this may appear a large figure, it amounts to less than 2 per cent. of the total output of coal in the world, which, on the average of the last five years, was 632,000,000 tons per annum. Assuming, however, an average cost of coal of 10s. per ton, this 11,720,000 tons represents

£5.860,000 yearly, an amount which it would take over £100,000,000 of capital earning 5 per cent. per annum to provide.

Apart from mere magnitude, many of the more recent examples of hydro-electric engineering abroad, especially in America, are interesting by reason of the enormous distances over which the electric energy is being economically transmitted, and the very high electric pressures that in numerous cases are being successfully employed.

The longest distance over which transmission has so far been commercially effected is probably the 232 miles of line belonging to the California Gas and Electric Corporation, which stretches from the de Sabla power-house, *viâ* Cordelia, to the town of Sausalito, which is situated on the opposite side of the Golden Gate Straits from the city of San Francisco. What this transmission means will be realised when it is stated that the distance covered is about equal to that which separates Cambridge from Newcastle-on-Tyne. The same Californian company also owns the Colegate and Oakland transmission line, which runs 142 miles from the Colegate power-house, where 14,000 horse-power is developed from a head of water of 702 ft.

Another very long line is that which reaches from the electric power-house *viâ* Stockton and Mission San José to San Francisco, a distance of 147 miles, over which 10,000 horse-power is being delivered regularly. This line belongs to the Standard Electric Company, who have 217 miles of power line, with a capacity of 27,000 horse-power in operation. The voltages employed, as it is to be expected having regard to the distances covered, are very high, ranging from 55,000 to 67,000 volts, 60,000 volts being apparently the standard figure for many recent installations, of which the following are some examples:—

Plants recently Installed by the Stanley Electric Manufacturing Company, Pittsfield, Massachusetts.

Name.	Horse-power capacity.	Voltage.	Transmission distance.	Head of water.
			Miles	Feet.
Quanajuato Power and Electric Company, Mexico	8,000	60,000	101	300
Washington Water Power Company, Spokane	12,000	60,000	110	68
Kern River Power Company, Los Angeles, California......	16,000	67,500	110	—
Pierce Company	26,000	55,000	40	—
Mexican Light and Power Company, Mexico	—	60,000	110	1,500
Winnipeg General Power Company......................	10,000	60,000	60	40
Canadian Niagara Power Company	—	60,000	93	—
Electric Development Company of Ontario	—	60,000	93	—

For these particulars the author is indebted to Mr. C. C. Chesney, chief engineer of the Stanley Electric Manufacturing Company, who have recently installed these and numerous other similar plants.

Mention should also be made of the 50,000 horse-power and the 125,000 horse-power plants for the Canadian Niagara Power Company, and the Electrical Power Company of Ontario, contracted for by the Canadian General Electric Company, both of which will employ pressures ranging up to 60,000 volts; while to pass to another quarter of the globe, the Cauvery Falls electric power scheme in India has now been at work for over two years, and transmits 5,000 horse-power to the Mysore gold mines, a distance of 92 miles, using a pressure of 35,000 volts.

(*To be continued.*)

MINING AND METALLURGICAL INDUSTRIES OF SPAIN IN 1903.*

This report, by Mr. Ronald Macleay, of His Majesty's Embassy at Madrid, affords a very interesting insight into Spanish activity, both in its national aspect, in the tables giving the total output, and in minuter detail in the returns and reports from the various provinces. At the outset, a distinction is clearly drawn between the mineralogical and the metallurgical sides. The value of the minerals produced at the mouth of the mines in 1903 amounted to £5,398,741, an increase of £301,572 over 1902, while the value of metals produced at various works aggregated £5,923,100, an increase of £196,097 over the value in 1902. The mines absorb the bulk of the population engaged in these industries; 94,351 people were engaged in productive mines in 1903, an increase of 6,843 individuals in the mining population as compared with 1902. In 1903, 22,488 workpeople were employed in the works, as against 22,299 in 1902, being an increase of 189 persons during the year. The demand for mechanical power is increasing at a greater rate than is the absorption of the population in this employment. In 1903, the number of hydraulic engines at the works (probably water-wheels or turbines) was 83, of 3,340 horse-power, whilst in the preceding year there were only 53 of such engines, of a total of 2,525 horse-power; the steam engines employed in the works have increased by 21, of 3,480 horse-power. At the mines, 265 more steam engines were employed in 1903 than in the preceding year, representing an increase of 8,412 horse-power.

During the period under review, in the mining industry there has been an increase in the production of copper, iron, argentiferous iron ore, sulphur, mercury, lignite, lead, and common salt, while on the other hand there has been a decline in the production of tin, coal, manganese, and argentiferous lead. Of the output of the different factories,

* Diplomatic and Consular Reports, No. 623 Miscellaneous Series. Eyre and Spottiswoode, London.

hydraulic cement increased by 43,438 tons, cast-iron by 43,217 tons, sheet iron by 18,832 tons, steel by 6,451 tons; the output of nails, wire, and manufactured iron increased, but the production of wrought iron decreased by 10,902 tons. There was also a lessened production of certain classes of copper, zinc, and of quicksilver.

Zinc is worked at 126 mines, in which 2,971 persons are employed, the value of the output at the mouth of the mines being £157,044. Copper, worked at 501 miles, provided employment for 12,141 persons, the output of 2,799,789 tons being valued at £1,569,369. Iron ore (hæmatite), which is used so largely in England was obtained at 662 mines, in which 30,073 persons were engaged, the output of 8,304,150 being valued at £1,301,407. Coal, mined at 605 places, provided employment for 20,717 persons, of whom 1,203 were females (263 of these were under 18 years of age). Only 2,587,652 tons of coal were raised, the value being £709,210. Lead mines are of two classes, those producing ordinary lead, and those producing argentiferous lead. In the former 486 mines yielded 108,660 tons, valued at £363,584, and employed 9,177 persons. In the latter case 227 mines yielded 179,858 tons, valued at £896,806, and employed 10,941 persons.

The relative amount of male and female labour is given in the following Table;—

Males employed underground:—	
From 16 to 18 years	5,174
Over 18 years	36,799
Males employed above ground:—	
From 10 to 16 years	3,318
From 16 to 18 years	6,011
Over 18 years	40,270
Total number of males	91,572
Females employed above ground:—	
From 10 to 16 years	160
From 16 to 18 years	705
Over 18 years	1,914
Total number of females	2,797

To every 100 males, 3 females are employed, a proportion which, considering the nature of the work, is rather surprising for a European country.

The returns concerned with the metallurgical industries are models of concise and valuable information. The number of works are given in which different minerals are treated, the horse-power of the machinery in use, the amount of ore treated, and the quantity and value of the finished product. Only one factory was concerned with the working of zinc; employing 471 hands, and receiving 12,740 tons of ore (about one-twelfth of the total amount mined); 2,636 tons of zinc ingots and 2,649 tons of zinc sheets, valued respectively at £55,356 and £67,446, were produced. Nine factories were concerned with the winning of copper. In these, 1,660,092 tons of ore (about 60 per cent. of the output) were treated. The yield was 13,138 tons of copper cascara (*i.e.* of the shell or husk of copper obtained from copper in solution flowing over ferric oxide), valued at £551,806. There were also produced 7,704 tons of copper blister worth £416,021, and 5,906 tons of copper sulphate worth £88,596.

As regards the iron industries, the following Table shows most concisely what took place in the nineteen works in operation in 1903, where 11,220 males and 316 females were employed, and the indicated horse-power of the steam engines in use aggregated 33,386:—

Class of Product.	Output in tons.	Value of output in £.
Cast Iron	302,657	737,661
Wrought Iron	1,661	13,461
Sheet Iron	48,943	422,666
Manufactured Iron	7,571	129,464
Steel	24,177	204,308
Wire	2,038	20,787
French Nails	1,395	20,297

These works consumed 772,785 tons of iron ore, or about one-twelfth of the volume of the ore mined in that year.

As regards fuel, 756,758 tons of coal were converted either into patent fuel or coke, the respective productions being valued at £202,588 and £394,281. Only 352 females are employed in the metallurgical industries, of whom 41 are under 16 years of age, while 22,136 male workers are employed.

Of the provincial reports, mention need only be made of that from Vizcaya. The "Nuestra Señora del Carmen" iron works produced 111,562 tons of pig iron. Of this total, 89,258 tons were treated by the Bessemer process, and yielded 83,227 tons of steel; 4,150 tons treated by the Siemens process yielded 1,724 tons of steel; and 3,200 tons were used in puddling, and yielded 2,872 tons. The works known as "Los Altos Hornos de Vizcaya" obtained 76,393 tons of pig iron from 157,140 tons of ore. Of this pig-iron, 25,350 tons were converted by the Thomas process into 21,569 tons of steel, and 12,716 tons yielded 3,043 tons of basic steel. The "San Francisco" Iron Works converted 78,716 tons of ore into 38,543 tons of pig iron: these works produced 2,530 tons of steel by the Siemens process, but from pig iron that was in stock from the preceding year. All these figures serve to show in a striking manner the trend of an industry to the source of one of its raw materials. How far, if at all, imported fuel from Great Britain serves to feed the Spanish furnaces is not stated.

One misprint, apparently the omission of an asterisk on page 9 may be mentioned. The yield of mercury stated is obviously an impossible one.

In its entirety, this report is both valuable and interesting. If it and its fellows received more attention from the daily Press, we should hear far less of the alleged superiority and surpassing commercial value of the American Consular Service.

LETCHWORTH.

On Wednesday next, the annual meeting of the Garden City Association will be held at Essex-hall, and the publication of the sixth annual report is an opportune time for glancing at the progress of a very interesting experiment. The primary object of the Association, namely, to secure healthful and adequate housing in a city in which the inhabitants shall become, in a collective capacity, the owners of the sites, subject to the proper recognition of public as well as individual interests, must command the sympathy of all. Nor is it less desirable to encourage the tendency of manufacturers to remove their works from congested centres to the country. The difficulties in the way of such an enterprise are obvious and many, but the Association seems to be making fair headway.

The estate upon which the experiment is being tried is about 3,800 acres in extent, situated between Hitchin and Baldock, in Hertfordshire. It has been purchased at about £40 per acre, inclusive of building and timber, and the town that is to grow out of it will be known as Letchworth, the population of the town area (1,200 acres), being limited to 20,000. A company, First Garden City Limited, has been formed with a capital of £300,000, of which £100,000 has been called up to develop the estate, but the profits of shareholders are limited to a cumulative dividend of five per cent. per annum, all profits beyond this being applied for the benefit of the town and its inhabitants. Considerable progress has already been made with the development of the town. Water works have been put up; several miles of mains have been laid; a large drainage scheme has been completed; an up-to-date gas plant will be ready for use in July; and various new roads have been constructed. Plots for a large number of houses have been let, and sites have been definitely selected by manufacturers, including G. Ewart and Sons, Geyser manufacturers, London; Idris and Co., mineral water manufacturers; Mr. A. W. Collier, stationery manufacturer; The City Press, printers; Hitchin, Vickers and Field, ashphalt manufacturers, London, The Garden City Laundry Company, London. Printers, lithographers, cabinetmakers, are likely to be particularly well represented at Letchworth. It is claimed that a manufacturer occupying an acre of land and a factory costing £10,000 in Garden City, will save £2,000 in rent and rates alone as compared with London, and as each of his *employés* will also obtain a saving in rent as well as a large garden the all-round advantage is much greater. Rates should remain low because the Garden City Company will do a large amount of the work usually done by local authorities, such as the carrying out of scavenging works, the interest on the capital unemployed being met by the revenue from building sites. The train service is excellent, there being 52 trains to and from Hitchin daily, the fastest taking 39 minutes from Hitchin to King's-cross. There will be sidings to each factory when needed, ample space for factories to be economically planned and extended when required, plenty of light and air, cheap and pure water, low insurance, cheap gas for power, cheap building materials.

For the workers there will be good housing, large gardens, and ample recreation. The rent for workmen's houses will be 5s. 9d. and 8s. a week. The house let at the weekly rental of 5s. 9d. has downstairs a living room, kitchen, scullery, and three rooms upstairs, each cottage being supplied with a bath. The 8s. houses have an extra room. Each cottage has attached to it a tenth part of an acre of garden ground. A well-known building society has agreed to advance up to £20,000 on the estate so that workmen will be encouraged to purchase their own dwellings, and many cottages are now being put up at a cost of not more than £115 to £130. In every case the society's architect must approve of the design. It is not intended that there shall be more than seven houses to the acre. The factories like the cottages will have to be built in accordance with the requirements of the Association. The freehold will not be parted with in any case.

There will be an agricultural belt round the town, and small culture will be encouraged. The promoters of the scheme properly attach great importance to the success of *petite culture*, but those who know the district are disposed to question the suitability of the soil. They say that it is almost impracticable land and only suitable for corn growing. It is a little surprising that the chairman of the company, when giving evidence before the Inter-Departmental Committee on Physical Deterioration, admitted that he thought it "very likely" that the land was as described, but that he had not inquired into the matter. If the land is not suitable for small culture a leading object of the Association will be defeated. And many other serious difficulties in the way of the general and permanent success of the venture will occur to all who give the matter consideration. For example, suppose the population of the city expands to the limit, and one of the manufacturers wants to increase his establishment to an extent that might mean the employment of another 200 or 300; or the cottages are allowed to go to rack and ruin as they do in the country; or that workmen, brought by a manufacturer, come from the slums of London; or that the middleman is allowed to creep in between the company and the manufacturer; or that the occupants of cottages disregard the restrictions as to overcrowding? These are some of the difficulties that the organisers of Letchworth will have to grapple with as time passes and the city becomes fully inhabited, but they ought not to be insuperable. Anyway, the experiment is one which deserves, and will command the heartiest good wishes of all who recognise how vital it is to the welfare of the country to lessen the overcrowding in our towns and the depopulation of the rural districts. The nature of their business must prevent many trades migrating to the countryside, but others are finding it

to their advantage to do so, for London is fast becoming an impossible centre for works of large dimensions, and the greater the decentralisation of trade the better the chance of enabling the workers to live in healthy surroundings such as they are promised at Letchworth.

EXPERIMENTAL SCIENCE IN THE SECONDARY SCHOOLS OF IRELAND.*

The education given in the secondary schools of Ireland is controlled and guided, in large measure, by a body of Commissioners known as the Intermediate Board. This Board was constituted by Act of Parliament in 1878, and administers a fund of about £90,000 a year. For many years this fund was distributed on the results of examination alone; and the programme of the Board was not favourable to the study of experimental science in the schools. But in the year 1900 the Board was empowered, under a new Act, to supplement examination by inspection, and, in the distribution of grants, take account of the results of inspection as well as the results of examination.

This change led to an important reform, in which the Board has been greatly aided by the co-operation of the Department of Agriculture and Technical Instruction. To this Department was transferred, in 1901, the administration of the Parliamentary vote for science and art in Ireland, which had been previously administered from South Kensington. As the Intermediate Board and the Department were dealing with practically the same schools, it was agreed to adopt a common programme in science subjects, and to carry out a common system of examination and inspection.

The programme adopted under this arrangement, which includes two years of a preliminary course and two years more of advanced teaching in various special subjects, is fully set out in the paper. It involved, in effect, an entirely new departure in the teaching of experimental science in Ireland; substituting, to a large extent, practical work in the laboratory for the study of books, and testing the efficiency of schools by actual inspection of the work done, as well as by written papers.

One of the chief difficulties encountered in the introduction of this new system was to provide a supply of competent teachers. This task was taken up by the Department, as the training of teachers does not fall within the functions of the Intermediate Board. The plan adopted was twofold. First, summer classes for teachers were held at various centres; and teachers who attend these classes, and afterwards satisfy the examiners, obtain provisional certificates to teach the course in which they have been so trained. This is only a temporary expedients intended to meet the urgent need of the moment.

But as the permanent element in their scheme the Department propose to grant the "Irish Teacher's Science Certificate" to all students who pass through a three years' course, prescribed for the purpose, in the Royal College of Science, Dublin. They will also recognise as qualified teachers students who have followed a similar course in any university or technical college, and who have obtained the corresponding degree or diploma.

The next difficulty was the want of laboratories and laboratory equipment. This difficulty has been met by the cordial and very remarkable co-operation of the schools and the local authorities with the efforts made by the Department and the Intermediate Education Board. The Department designed plans to suit the circumstances of each particular school and prescribed the necessary apparatus to be provided. Then loans were advanced by the Intermediate Board, and grants were made by the Department to help the schools to meet the cost of building and equipment. The county and borough councils also lent their aid in many cases, by allocating to the same purpose a portion of the funds placed at their disposal for technical education. The result has been that 214 schools are now provided with all that is needed for the two years' instruction of the preliminary course; and many of these are further provided with the equipment prescribed for one or more years of the special courses.

The new system now embraces all the secondary schools of the country, about 250 in number, with a school population of about 20,000 pupils. Of these 20,000 pupils, somewhat more than 9,000 were under instruction in the preliminary course during the school year 1903-4, and about 1,500 in one or more of the special subjects. This represents a very satisfactory progress, in what is practically a new line of study, within the short period of four years.

It is encouraging to hear that the subject of experimental science, taught on the new lines, is popular both with teachers and pupils. I am informed that a large number of pupils have developed quite a remarkable taste for laboratory work, and that many who had been regarded as dull and inert in other studies, have shown themselves alert and bright in this new field of nature knowledge that has been opened to them.

* Abstract of paper read by Rt. Rev. Gerald Molloy, D.D., before Section L of the British Association at Cambridge.

COTTON PICKING MACHINE.

Mr. George A. Lowry, of Boston, Mass., a member of the Society of Arts, has invented a machine which has been exhibited in action at Shreveport, Louisiana. The following account of the demonstration is taken from the *Shreveport Times* of December 18th last :—

The inventor of the Lowry auto-cotton picker claims that his machine, operated by five boys, will pick twenty-five times more cotton than the average negro

hand picker of the south, and the demonstration of his machine was given in the presence of many prominent cotton men of Shreveport and planters from the surrounding country on the Foster plantation, three miles from the station, on the 17th December.

Mr. Lowry and Colonel Jerome Hill, of Memphis, who has been in business in that city for thirty years or more, have been in the city since the opening of the national cotton convention, and intended to give an exhibition of the cotton picker on the 14th inst., but on account of the non-arrival of the machine the exhibition was postponed. The trip to the Foster plantation was made on a special train over the Vicksburg, Shreveport and Pacific railroad.

The machine picked one whole and two half rows of cotton clean within a very short space of time. All of the witnesses were of the opinion that Mr. Lowry had the correct theory; that the machine he has now, which is to some extent in a crude state, would, when perfected, do everything its inventor claimed for it. The machine did what it was advertised to do, and that was really to pick cotton.

In picking with the Lowry picker human brains direct the machinery to the open bolls, the machine withdraws the cotton from the boll, carries it to the bag, and carries the bag. The operator is seated, and his only duty is to see that the machine, or that portion of it which is termed the "arm," is brought into contact with the open bolls. The machinery does all of the other things, and does them well. Four negro boys, two of whom never before saw the machine, operated the "arms," and each picked at the rate of 126 bolls per minute. It is estimated that the machine will pick at least 3,000 pounds of cotton in one day. This estimate is made on the accepted ratio that it requires the seed cotton out of from 70 to 100 bolls to weigh a pound. Gasoline furnishes the motive power for propelling the machine, and the cost of a day's consumption is a very small item.

The cotton bolls used in the demonstration were as full as they could possibly be, and the plant was dry and brittle, but notwithstanding this the cotton was picked almost without any trash.

A special feature of the Lowry cotton picker is its simplicity, which will make it a hard matter for it to get out of gear, and any man who has ever operated a common gin can operate the picker.

After the exhibition, which lasted about an hour, the following resolution was unanimously adopted and signed by all present:

"Resolved, That, having witnessed on the Foster plantation, near Shreveport, La., the Lowry cotton picker at work, we are pleased to certify it as a success and an invention that solves the most serious problem that confronts the cotton-grower to-day, and we thank and congratulate Mr. G. A. Lowry for having conceived and put into operation a machine that enables one man to pick five times as much cotton as he could with his unaided hands. We commend it to the cotton producers of the south."

BOOT AND SHOE INDUSTRY OF THE UNITED STATES.

The last official census of the United States shows that there were in operation in this country during the census year 1900 1,600 boot and shoe factories, representing a capital of 101,795,233 dols., giving employment to over 150,000 people, and having an annual product valued at over 260,000,000 dols.

During the past ten years the number of factories has decreased by 23·2 per cent., the amount of capital has increased by 6·8 per cent., aud the value of the product has increased by 18·3 per cent. In 1890 there were in operation 2,082 factories with a product of 220,000,000 dols., and during the ten years a large number of the small establishments have either closed entirely or were absorbed in larger companies, the tendency of the time being toward consolidation of the business into large establishments.

Another feature of the development of the industry in the past ten years is the increased use of machinery and the improvements in methods. In spite of this, however, the figures prepared by the census show that it is costing more to manufacture shoes at the present time than it did ten years ago. There was an increase of 42·8 per cent. in the cost of materials during the decade while the value of the finished product shows an increase of 18·3 per cent.

Since the invention of the rolling machine—the first practical mechanical substitute for hand labour—there has been constant progress in the perfection of shoe machinery. The shoe factory of to-day provides a perfect system of continuous manufacture, involving, in some instances, more than 100 operations. The continued improvement of the various machines, together with the keen competition in the business, has made necessary the adoption, as soon as perfected, of the latest devices. This will be seen in the increase for 1900 over the previous year in the value of machinery, tools and implements required for a product valued at 100 dols. The total increase for this item is 3,083,941 dols., or 22·2 per cent. for the industry.

While the manufacture of boots and shoes in other sections of the United States has made marked progress, New England still maintains the lead in the industry, the output for that section in 1900 representing 59·5 per cent. of the total for the United States. The output of the factories of Massachusetts for 1900 was 117,115,243 dols., or 44·9 per cent. of the total for the entire country, compared with 52·7 per cent. in 1890, a decrease of 7·8 per cent., although showing a small increase over the value of the products of the State for the decade.

Massachusetts ranks first in the value of production as well as in all other points in connection with the manufacture of boots and shoes. The total capital invested in this industry in that State was 37,500,000 dols., and the total number of wage earners was nearly 60,000, and the value of the product 117,115,000 dols.

New York ranks second in the amount of capital, average number of wage earners, and value of products. From 1890 to 1900 the gain in capital was 32,348 dols. in a total of 11,983,239 dols., while the output increased from 23,661,204 dols. to 25,585,631 dols.

The third rank in point of production belongs to the State of New Hampshire. This State shows an output valued at 23,405,558 dols., with 12,007 wage-earners, who received 4,971,954 dols. In 1890 it required 7,912 workers to produce 11,986,003 dols., the State then ranking fourth in all items except that of capital.

Ohio ranks fourth in the value of its product with a total of 17,920,000 dols. The capital invested in Ohio was over 7,500,000 and the number of *employés* 12,7000. The value of the product of boots and shoes in the United States, divided according to the principal lines, was as follows :—

Products.	Number of Establishments.	Quantity (pairs).	Value.
Men's boots and shoes	561	68,042,839	$108,705,938
Boys' and youths' boots and shoes	389	21,080,479	20 799,297
Women's boots and shoes	589	65,372,953	82,504,303
Misses' and children's boots and shoes	552	42,043,202	30,319,611
Men's and boys' and youths' slippers	136	4,456,965	2 812,213
Women's, misses' and children's slippers	279	12,655,876	10,146,393
All other kinds	127	5,583,405	2 491,511
All other products	161	—	2,175,738
Amount received for custom or contract work	148	—	1,073,576
Total	—	219,235,419	261,028,580

The lists of the cities in the United States having an output of boots and shoes valued at more than 5,000,000 dols. is as follows :—

Cities.	Rank.	1900. Value of Product.
Brockton, Mass.	1	$19,844,397
Lynn, Mass.	2	16,830,733
Haverhill, Mass.	3	15,231,440
Cincinnati, Ohio	4	8,788,424
St. Louis, Mo.	5	8,286,156
Rochester, N.Y.	6	6,933,111
Philadelphia, Pa.	7	5,931,045
Brooklyn, N.Y.	8	5,733,432
Chicago, Ill.	9	5,723,126

A noteworthy feature of the history of the development of the boot and shoe industry in this country is the fact that until well along in the last century there was little or no attempt to establish the industry outside of eastern Massachusetts, at the present time in New York City and in other parts of New York State, especially in Rochester, the industry has assumed large proportions and has reached a high state of perfection. In Newark, New Jersey, where the business was early established, there are now made many of the finest shoes for men.

Philadelphia has long ranked the manufacture of shoes as among the most prominent of its many manufacturing industries. In Cincinnati and in St. Louis during recent years shoes have been produced in great quantity and of excellent style and finish. Chicago has also taken up the industry with characteristic energy and has assumed a prominent place at the present time. All through the West, including the Pacific Coast, new factories are being established which are thoroughly well equipped and promise to be successful.—*Commercial America.*

A PLAN FOR A UNIFORM SCIENTIFIC RECORD OF THE LANGUAGES OF SAVAGES.*

During the last thirty years, the careful record of "savage" languages has been frequently undertaken, and a serious difficulty has arisen owing to the accepted European system of grammar, which is based on a system originally evolved for the explanation of highly inflected languages only, whereas in many, if not in most, "savage" languages inflection is absent or present only in a rudimentary form. The European system has therefore been found to be unsuited for that purpose. During attempts to provide a suitable system a theory of universal grammar was evolved.

The root idea is that, as speech is a convention devised by the human brain for intercommunication between human beings, there must be fundamental natural laws by which it is governed, however various the phenomena of those laws may be.

The theory starts with a consideration of the sentence, *i.e*, the expression of a complete meaning, as the unit of all speech, and then seeks to discover the natural laws of speech by a consideration of the internal and external development of the sentence.

In explaining internal development the sentence is ultimately divided into words, considered as components of its natural main divisions, in the light of their respective functions. This leads logically to a clear definition of grammatical terms.

From the consideration of the functions of words, the theory passes to that of the methods by which they are made to fulfil their functions. It shows how words can be divided into classes according to function and explains their transfer from class to class. This leads to an explanation of connected words and shows how the forms of words grow out of their functions. The growth of the forms is next considered, involving an explanation of roots, stems, and radical and

* Abstract of paper read by Sir Richard Temple, Bart., C.I.E., before Section H of the British Association meeting at Cambridge.

functional affixes. This explanation shows that the affixes determine the forms of words. This is followed by a consideration of the methods by which the affixes affect the forms.

The sentence, *i.e.*, the unit of speech, is then considered as being itself a component of something greater, *i.e.*, of a language. This consideration of its external development leads to the explanation of syntactical and formative languages, the two great divisions into which all languages naturally fall—*i.e.*, those which depend on the position of the words, and those which depend on the forms of the words, in a sentence to express complete meaning.

Syntactical languages are then shown to divide themselves into analytical, or those which depend for comprehension mainly on the position of the words, and into tonic, or those which combine tone with position for the same purpose. So also formative languages are shown to divide themselves into agglutinative and synthetic, according as the affixes are attached without or with alteration. Formative languages are further divided into premutative, intromutative, or postmutative, according to the position of the affixes.

The theory further explains that, owing to a fundamental law of nature, no language can have ever been left to develop itself alone, and how this leads to the phenomena of connected languages, and thus to groups and families of languages. It also explains how—again according to a law of nature—no language has ever developed in one direction only or without subjection to outside influences, leading to the natural explanation of the genius, or peculiar constitution, that each language possesses.

It is believed that every language must conform to some part or other of the theory, and it can be shown that children and untutored adults in learning a language act on the instinctive assumption of the existence of such a theory. Assuming the theory to exist and to be correctly stated, it is of great practical importance as leading to the quick, accurate, and thorough, because natural, acquirement of a new language.

In brief, the theory is based on the one phenomenon which must of necessity be constant in every variety of speech, viz., the expression of a complete meaning, or, technically, the sentence. Words are then described as components of the sentence, first, as to the functions performed by them, and next as to the means whereby they fulfil their functions. Lastly, languages are considered according to their methods of composing sentences and words.

Phonology and orthography—*i.e.*, pronuuciation, spelling, and alphabets—are not considered, as these belong to other branches of the development of the human mind.

The theory has been already applied—and, it is claimed successfully--to sixteen languages, including English, Latin, and Hungarian, selected for the purpose as being illustrations of every type and every kind of development.

THE MINING INDUSTRY OF BRITISH INDIA.

There has of late been a distinctly satisfactory progress in the mining industry of India, the most marked development being in the production of coal, gold, petroleum, and manganese ore, while progress has also been made in the minerals of smaller value. Activity in prospecting has also shown a decided increase, for the number of prospecting licenses issued in 1903 was 90, as compared with 83 in 1902. Owing to the dullness of the coal trade in 1903, the output of coal in that year, though progressive, showed an arrest of the rapid expansion which has characterised the industry for several years. With a total production of 7,438,386 tons, India now takes the lead as a coal producer in the British Empire outside Great Britain. The Raniganj Jherria and Giridih coal fields still retain their lead as coal producers, and the proximity of the first two to Calcutta enables them to meet the requirements of the export trade, which, however, is necessarily confined to Indian Ocean ports, and consequently somewhat limited. India is yearly approaching a state of being able to supply all her own wants in fuel, as the import of foreign coal has been shrinking rapidly, and amounted in 1903-4 to 180,040 tons imported as merchandise, and 26,789 tons as Government stores, this being one-fourth of the quantity imported nine years previously. All but a quarter of the private imports was, on the authority of the Director-General of Statistics at Calcutta, English coal, mostly landed in Bombay, the remainder coming from Australia and Japan. The Indian railways take, naturally, a large share of the coal produced in the country, the consumption having risen steadily from 1,059,158 tons in 1894 to 2,203,889 tons in 1903. In the case of gold, besides the steady rise in output from Kolar, where the gold mining industry has gradually expanded since 1894, and during 1903 reached a total of 600,000 ounces, work has commenced in the Nizam's dominions, and during the ten months, February to December, 1903, 3,414 ounces of gold were raised. In Burma there has been a decline in the output, from 2,179 ounces in 1902 to 1,095 ounces in 1903, on account of the exhaustion of the reefs in the Katha district. A certain amount of washing for gold is carried on in the rivers of the Punjab, Chota Nagpur, and Burma, and dredging operations with promising results have commenced in the upper reaches of the Irawadi river. The development of the petroleum resources of Burma and Assam has exceeded the rate of growth in the coal trade. In 1902 the production amounted to nearly 57 million gallons, and this represented a substantial increase on previous years. In 1903 the output rose to nearly 88 million gallons, of which over 85 million gallons were produced in Burma. The production for Assam has risen from about 1¾ million gallons in 1902 to 2½ millions in 1903. In addition to a low-grade burning oil and solid paraffin, petrol is

now being manufactured. The most remarkable development has taken place in the quarrying of manganese ore. This industry, commenced little more than ten years ago by quarrying in the deposits in the Vizianagram State, and from an output of 3,130 tons in 1893, the production rose rapidly to 87,126 tons in 1899, when the richer deposits in the Central Provinces were also attacked, and are now yielding a larger quantity of ore than the Vizianagram mines. In 1903, the total output for India reached a record of 171,800 tons, which places India amonst the first two of the countries producing high-grade manganese ore. The ore raised in the Central Provinces is of a very high grade, ranging from 51 to 54 per cent. of the metal, and is used principally in steel manufacture in Great Britain, Germany, and the United States. The production of salt in India, which averages about a million tons annnally, fluctuates with the seasons. The total in 1903 was only 894,840 tons, owing to the much smaller production in Bombay and Madras. The largest proportion of salt produced in India is sea salt, made on the coast in Sind, Bombay, Madras, Burma, and Aden. The quantity so made on the Indian coasts in 1903 represented more than two-thirds of the whole production. Saltpetre, which is largely produced for export, was in former years of much greater importance than now, the diminished demand for gunpowder and the preservation of food, with the competition of the nitrates, having operated to prevent an expansion of the exports. It is most largely produced in Bihar, whence the article is sent to Calcutta for export after refinement. The native iudustry in smelting iron, which has existed in most parts of India from very ancient times, has undergone a gradual decline in the face of cheaper iron and steel imported from Europe. Except in Barakar, where the conditions for the manufacture of pig-iron are favourable on account of the proximity of ore supplies and good coking coal, no successful attempt has been made to manufacture iron on a large scale in India. In the case of mica, India still retains the lead among the producing countries. The centres of production are in the Nellore district in the South, and a belt of pegmatiles near the borders of the Hazaribagh, Gaya, and Monghyr districts in Bengal. Little or no work has been done in the other areas where the mineral is known to occur in plates of marketable size and quality. The mining for graphite still continues in the Travancore State, where the mineral occurs under geological conditions similar to those of the richer deposits being worked in Ceylon. The output for 1903 amounted to 3,394 tons, as against 4,595 tons in 1902. Amongst other minerals of value, the magnesite deposits of the so-called "Chalk Hills," near Salem, in the Madras Presidency, have attracted attention on account of the great purity of the mineral, which is found to be suitable for the manufacture of fire bricks for linings and hearths of steel furnaces. Complete statistics of the output of jadestone in Burma are wanting. The substance which passes as jadestone is mainly the mineral jadite which occurs with serpentine in an altered igneous rock in the Myitkyina district of Upper Burma. Tin mining is carried on on a small scale in Southern Burma and the Karenni. The quarrying of slate is an important industry along parts of the outer Himalayas, near Rewari in the Punjab, and in the Kharakpur hills of Monghyr district. In the Kangra valley the material obtained is a highly fissile quartz schist, not a true slate, and in consequence of the facility with which it can be split into thin large sheets and resists the action of the weather, it is for roofing purposes superior to ordinary clay slate.

"BASTARD" LOGWOOD.

A correspondent of *Nature* quotes from the Jamaica *Bulletin* of the Department of Agriculture for November, 1904, an article on this subject by B.C. Gruenberg and William Gies, contributed originally to the *Bulletin* of the Torrey Botanical Club.

During the past few years the growers of logwood in Jamaica have been greatly disturbed by an apparent increase on their properties of an unmerchant able variety of the plant known as "bastard" logwood; the exportation of this wood along with real logwood has served to condemn all the logwood from the districts which have shipped it.

"Bastard" logwood differs from the genuine varieties, from the dyer's standpoint, in yielding little or no hæmatoxylin, but instead a yellowish-green pigment which is of no value, aud which, when mixed with the commercial extract, reduces the characteristic tinctorial properties. Chips of the "bastard" logwood present a yellow, pale pink, white, or even chocolate-coloured surface, instead of the dark red or deep purple bronzed-tinted colour of the best logwood. There appears great uncertainty, even when the trees are cut down, as to whether a tree is really a "bastard" tree or not. What is known as a "bastard" tree is frequently dark enough when first cut to lead one to believe that it is a good red-wood tree, but instead of darkening with age it remains the same colour, or becomes lighter rather than darker. "Bastard" wood is not the result of disease or of any lack of vigour; the trees producing it are perfectly healthy and normal.

It is not the result of soil or climatic conditions, since bastard and normal trees are found growing side by side under absolutely identical conditions.

It is not the result of immaturity; aged trees may produce bastard wood.

These facts point to heredity as the probable cause of the trouble: that is, certain trees produce "bastard" wood because they grow from seed of a "bastard" tree; in other words, "bastard" logwood is a variety of *Haematoxylin Campechianum* that normally produces little or no hæmatoxylin. The chemical differences existing among all these logwoods are quantitatively very slight, and there are no strik-

ing structural differences among all the varieties of logwood.

There can be no doubt that "bastard" logwood is a distinct variety or subspecies of *Haematoxylin Campechianum*, notwithstanding the slight morphological difference that distinguishes it from the "red" logwood and blue logwood.

The Jamaica *Bulletin* has done good service to the colony in bringing the fact prominently before the planters that the admixture of useless wood which has been the source of unnecessary loss to them may be avoided.

PAPER-MAKING MATERIALS IN CHINA.

Rice straw is the commonest paper-making material in the province of Ssuch'uan, which derives its name of "Four Streams" from the four rivers, Chialing, F'o, Min, and Yaling, flowing through it from north to south into its great trade highway the Yangtsze, and is the largest and probably the richest province of the empire of China. This straw paper, of which there are several qualities, is used for wrapping goods, in the manufacture of fire crackers, for making paper money, so much in demand at all funeral ceremonies, for pipe spills, and for a variety of other purposes. The straw is made up into bundles and steeped with water in a deep concrete pit for a month, when it is taken out and well washed. The water in which it has been steeped is removed, and the straw is spread in layers in the pit, each layer being thoroughly sprinkled with slaked lime, and water containing the catty (1⅓ English pounds) of soda to each 100 catties (133⅓ lbs.) of lime. There it remains for 20 days. At the end of this period the straw has been reduced to a pulp, which has sunk to the bottom of the pit. The surface water and as much as possible of the lime are removed, and the pulp is taken out, placed in a steamer and steamed with 1 per cent. weight of soda, when it is ready to be made into paper. A quantity of the cold pulp is placed in a trough of cold clean water, to which is added some mucilage extracted from the *Hibiscus Abelmoschus*, a wild plant and cultivated in Ssuch'uan, and a fine oblong bamboo frame, the size of the desired sheet of paper, held at the two ends by a workman, is drawn down endways and diagonally into the liquid contents of the trough. The contents are well stirred before the frame is used. It is then gently raised to the surface, and the film what has gathered on the top, drops off as a sheet of moist paper when the frame is turned over. This paper is kiln dried and made up into bundles for market. The following, according to Consul General Hosie, is the method employed in making the paper money or paper cash referred to above. The trunk of a tree six feet or more in circumference, and about six feet high, sat up in the verandah of a shop is the usual signboard of a paper cash factory. Standing on a scaffolding which brings his elbows well above the top of the trunk a man takes a bundle of this coarse paper several inches thick and about six inches square, and with a wooden mallet exactly the same as that used in finer stone work in England, hammers an iron chisel consisting of a central pointed iron spike with two sharpened concave scoops on either side through the paper till the spikes and scoops reach the trunk. This he repeats in parallel lines all over the bundle till each sheet is covered with cash shaped perforations consisting of a round centre and two half moon shape slits held together by the paper between the scooped openings. The sheets are always used whole, and no attempt is even made to subdivide them into the cash which they represent, but the paper is so cheap that even a Chinese does not think it worth his while to study economy in this matter. Sheets of paper cash are scattered on the roadway in front of the coffin when being borne to the grave, and burned at the grave itself after the burial has taken place. This paper is also moulded with tin into the shape of sycee, and it also goes largely to make up the flimsy sedan chairs which are burned at the grave as offerings to the departed. Two kinds of bamboo are used in Ssuch'uan for the manufacture of paper, the "Tzu Chu" and the "Chin Chu." They must be tender stems usually of the same year's growth, and in no case must they be more than two years old. They are cut into lengths of eight feet to suit the size of the concrete pit, where they are steeped in bundles with cold water, and heavily weighted with stones. After three months they are removed, opened up and well washed. They are then stacked in layers, each layer being well sprinkled with lime and water containing about two pounds and a-half of soda to every 133 pounds of lime. After two months they are well retted. The lime is then washed out, and they are steamed for fifteen days with three pounds of soda to every 130 pounds of the fibrous mass which on removal from the steamer is thoroughly rinsed with cold water. It is then placed in a concrete pit and reduced to fine pulp with wooden rakes. After this it is ready for conversion into paper. A quantity of the pulp is put into the trough, with cold water and mucilage from the *Hibiscus* referred to above, as in the case of the coarse straw paper. The whole is thoroughly stirred and the frame passed into the trough and raised with the film of paper in the usual way. This paper is much finer, whiter, thinner, and more expensive than straw paper. There are of course various qualities used for different purposes—from papering windows to fine writing and note paper. Much of this paper is coloured on one side as well as dyed, and very often note or card paper is glossed with white wax to give it a smooth polished surface. Paper is manufactured all over the province of Ssuch'uan, but the great centres for bamboo paper are Mien Chu Hsien, Chiung, Chou, and Chia-chiang Hsien, while Lu Chon on the Yangtsze, west of Chungking, produces very large quantities of straw paper. The *Broussonetia papyrifera*, or paper mulberry, attains

to the dimensions of only a bushy shrub, but no attempt is made in the provinces to manufacture paper from its inner fibrous bark. The tough "bark paper" or "Pi Chih" made from this plant, and so extensively used in China, comes from the province of Kueichon. There is one prominent use to which this light, pliable, tough paper is put in Ssuch'uan. In all fur-lined and wadded garments the chief desiderata are lightness, warmth, and the protection of the material lined from being frayed by the skin or wadding. As is well known a fur is usually made up of a number of skins sewed together and these seams present an uneven surface which would in time wear the silk or satin material lined. This wearing is prevented by inserting a layer of this paper, which presents an even surface to, and preserves the material. Cotton and silk wadded garments are treated in the same way when there is a risk of unevenness proving injurious. Lightness, warmth, and durability are the result. The *Fatsia papyrifera* is the source of the fine thin pith paper so well, but erroneously known in China, as "rice paper." The plant which has no connection whatever with rice, is cleverly shaved from the round pith of the plant by means of a sharp heavy knife. The pith is largely exported. In Canton this paper is largely used for painting, but in Ssuch'uan it is mostly converted into artificial flowers. It grows wild throughout the province.

IMPROVEMENT OF COTTON GROWING IN INDIA.

One result of the formation of the British Cotton Growing Association has been to call attention to the great deterioration which has taken place in the quality of the cotton grown in India during the last twenty years. The Association's investigations have caused the Government of India to consider what steps it could take to improve the grade of the cotton exported from India. The Department of Revenue and Agriculture has accordingly issued to the various provincial governments a long letter on the subject. The Government recognises that the question is largely a commercial one, and that cotton growing will expand only if cotton is made more profitable to cultivators than other crops, and that the longer or finer staples (which are so highly prized in Lancashire) will be grown only if they prove more profitable than short staples, for which there is already a very large foreign demand. Mnch has already been done by the Inspector-General of Agriculture in pushing on systematically a botanical survey of Indian cotton, while the steps now being undertaken should prove very effective in improving the staple.

One of the main causes of the deterioration of Indian cotton has been due to carelessness in the selection of the seed. This has been occasioned by the practice, which has become general in recent years, of sending all the cotton grown to ginning mills, and getting back for sowing purposes any seed which might be ready for sale. The Government memorandum, therefore, suggests that in order to collect a sufficient quantity of good seed, agents of the Agricultural Department should be appointed in each cotton-growing district as seed collectors, to go round at the cotton picking season and select the best fields of the local well-known varieties. The produce of the fields selected would be purchased, the seed hand-ginned, collected, and carefully stored, the lint of the crop being sold to the best advantage. Only the seed from healthy plants would be taken, and this would be sold or distributed to cultivators on the approach of the next sowing season. The aid of the owners of the cotton ginning mills is to be enlisted, in order that they may gin separately any good lot of cotton, separating its seed for sale only to those parts of the country proved to be suitable for that particular variety of cotton. In order to further the adoption of this proposal, the Government of India is willing, if any local Government accepts the scheme and is prepared to spend an equal sum from provincial resources, to contribute a grant of 5,000 rupees.

The Indian Government has also agreed to contribute in equal shares with the British Cotton Growing Association, a sum of £6,000 towards the resources of a syndicate formed to promote the growing of long stapled cottons. Besides starting practical cultivation on a large scale, the syndicate will undertake the experimental cultivation and selection and improvement of suitable varieties of seed. When the varieties likely to give the best results have been ascertained, they will be cultivated on a number of small demonstration farms, for the purpose of illustrating to the ryots the advantages they promise and the best methods for their cultivation. The main object of the syndicate is, of course, to increase the production of long-stapled cottons suitable for the Lancashire mills.

TECHNICAL EDUCATION IN THE FAR EAST.

Professor Perry and his fellow labourers, who, some twenty years or so ago, by their services at Tokio University (and elsewhere) in Japan, founded Japanese technical education, will be interested to learn that a number of young Nepalese and Hindu students are now studying in Japan. Comparatively few young Indians come to England to study technical subjects. Occasionally a young Mohammedan has won honours at Cooper's Hill, while some years ago the Gaekwar of Baroda sent over several young Hindus to study technical subjects. Of course large numbers of Indians always come to London to read for the Bar. It seems that the high caste Hindu or Mohammedan of old family regards the law as more dignified than manufacturing or railway work. The only entrance to the Indian Bar being *viâ* the Inns of

Court, no counter attractions lead them to study law elsewhere. In regard to technical study Japan now seems to be offering the special attractions of a cheap training, together with less disagreeable climatic changes. The entrance standard at Tokio University is a high one. Quite apart from the Japanese language, which the regulations state should be read in primers before leaving India, and which can be learnt in about eight months, German must be learnt. It seems that all Japanese students on entering the University are able to read any German books on a a technical subject, and that many of the professors freely mix German and English technical terms in their lectures, while others make exclusive use of German terms.

Technical education in India has been specially patronised by Lord Curzon, and the various colleges of Sibpur, Rurki, and Madras train large numbers of engineers for the Government service. It is surprising though that fifteen Indian students are at Tokio (eight of whom come from Nepal), while others are at Kobe and Osaka. At the present time it is doubtful whether there are five Hindus in England studying engineering subjects. Whether the young Hindu will find it wise to learn two strange tongues in addition to the English learnt at school, is another matter. Experience alone will show whether the climatic compensations will counterbalance the scholastic loss, if such there be.

CANARY ISLANDS TOBACCO.

The Spanish Government, in order to help the farmers who grow tobacco, has compelled the tobacco régie in Spain to take from the Canary Islands every year for the next four years 220,000 pounds. At present the crop amounts to 132,000 pounds, but more will be planted in the future. The Government has also sent an experienced horticulturist to see to the cultivation and consider what improvements can be made, so that Spain at some future day may be independent of Cuba in regard to certain qualities of tobacco that are bought there. The tobacco will only be bought from the growers and none will be accepted from dealers or speculators. All samples will be transmitted to Madrid subject to the approval of the board of governors of the tobacco régie before being bought, and the price paid for the tobacco will be the same as the ruling price paid in Habana for Remedios tobaccos at the time these crops get to the market. In the island of La Palma, where nearly all of the tobacco of the Canary Islands is grown, fully 20 per cent. of the male population have been at one time or other in Cuba, and have worked in tobacco plantations. The American Consul at Teneriffe, who has had considerable experience in the tobacco trade, gives it as his opinion that the quality of the tobacco grown in La Palma is far better than the Remedios of Cuba; all that is necessary, is to give more attention and care to the planting and cultivation, as well as to the curing. He is also of opinion that in years to come it will compare favourably with the famous Vuelta Abajo crops.

CORRESPONDENCE.

RUBBER CULTIVATION IN SIAM.

In the number of the *Journal* for November 11 (p. 886) I find an article with the heading written above which contains more erroneous and extraordinary statements concerning the cultivation of rubber plants than is usual in ordinary popular papers, and was hardly to be expected to be met with in the *Journal* of the Society of Arts. Consul-General Nash, of Bangkok, fears, it seems, "the so-called disease which has developed in the Para rubber plantations of the Malay Peninsula. About this pest nothing very definite can be learned, except that it attacks the leaves and is very destructive." There is *no* such disease known in the Malay Peninsula; there is *no* disease of any part of the Para tree of any great importance or which could possibly be called very destructive. The author is probably referring to the canker of the stem and branches which has been seen in one or two cases in the Malay Peninsula. It is not very important, and is very easily checked. He next proceeds to state that *Ficus elastica* is found in large quantities in the Siamese jungle and throughout India and Indo-China generally. It is certainly absent altogether from the greater part of India, but occurs in Assam. It may occur in Siam and Indo-China, but it is certainly not abundant. The amount of rubber taken from six-year-old trees, *i.e.*, four pounds, is much exaggerated.

As to the wonderful *Urceola*, with its extraordinary growth of six or seven feet in two or three weeks, one would certainly be glad to know more about it, as its growth as given, is just four times as rapid as the most rapid-growing plant of any kind known to botanists, viz., four inches a day.

Equally extraordinary is the statement that the rubber is obtained by cutting the creeper into sections two or three feet long and collecting the juice. "The bark is also used, and being pounded and boiled, gives about 10 per cent. of inferior rubber." The rubber latex, in all species of *Urceola*, *Willinghheia*, &c., is *confined exclusively to the bark.* There is nothing to be got out of the stem other than the bark except water. The writer has probably confused the native methods of dealing with these plants, common all over Eastern tropical forests, by hacking at the creeper so as to draw off the latex from the bark, with a process employed in French Indo-China of treating the bark collected by the natives in the forests and brought to the settlements. The fact is that the rubber-vines *Urceola*, *Willughbeia*, and *Landolphia* are slow-growing plants, which have never yet, I believe, been cultivated successfully, as

they only produce after many years slender stems which can never be utilised for rubber production. They seem equally slow-growing in the forests, but in dense jungle eventually produce stems several inches through. As a jungle product, the rubber-vines have a value, but as cultivated plants practically none. There is no difficulty at all in obtaining botanical information on Mr. Nash's marvellous *Urceola*. He has only to send specimens with fruit and flowers to any one of the botanists at Kew, Calcutta, or Singapore, and he can get full information. As no plant answering his description is known, and it is very improbable that any number of rubber-vines have been introduced into Bangkok, it is more than "*possible* that the plant is indigenous" to Siam it is certain.

As of late years a great deal has been discovered and published as to the cultivation and methods of preparation of all kinds of rubbers, it is very much to be regretted that such misleading articles as the one quoted should be published.

HENRY N. RIDLEY,
Director of Gardens, Straits Settlements.

[The statements criticised by Mr. Ridley are taken from the Report of Mr. Paul Nash, United States Consul-General at Bangkok, Siam ; No. 1,983 of the series of reports issued by the United States Department of Commerce and Labour.]

NOTES ON BOOKS.

CHINESE ART. By Stephen W. Bushell, C.M.G., B.Sc., M.D. Vol. I. (Board of Education, South Kensington, Victoria and Albert Museum), London.

Dr. Bushell, a diligent collector of Chinese books relating to antiquities and art industries, after a residence of thirty years in Peking, has, at the desire of the Board of Education, written a handbook on "The Art and Industries of China," of which the first volume has just appeared. This is devoted to sculpture, architecture, bronze, carving in wood, ivory, horn, &c., lacquer, and carving in jade and other hard stones. In the second volume the following subjects will be treated :—Pottery, earthenware, stoneware, and porcelain ; glass ; enamels : cloisonnés, champlevés ; and painted jewellery ; textile fabrics and embroidery ; pictorial art.

Although the mythical and legendary periods of Chinese history carry us back to a very early date, there are no relics of carved stone in China to be compared in importance or antiquity with the ancient monuments of Egypt, Chaldea and Susa, in fact the origin of sculpture in stone is very obscure in spite of all that has been written on the subject, in native as well as foreign books. Dr. Bushell says that calligraphy is a branch of fine art in China, and the penman who can write elegantly in sweeping lines with a flowing brush is ranked above the artist. The highest reverence is also paid to any ancient relics of stone and bronze with inscriptions. The most cherished relics of the Chou dynasty (B C. 1122-249) are ten stone drums, now installed in the two side halls of the principal gateway of the Confucian Temple at Peking, where they were placed in the year 1307 by Kuo Shou-Ching, the famous minister and astronomer of the reigns of Kublai Khan and his successor. They were really mountain boulders chiselled into the shape of drums, about three feet high.

With respect to Chinese architecture, the author says that the first impression of a general view of buildings is that of a certain monotony resulting from the predominance of a single type of architecture. China, in every epoch of its history, and for all its buildings, has kept to a single architectural model.

From the earliest antiquity the Chinese are recorded in their annals and traditions to have been acquainted with the art of moulding and chiselling bronze. The proportions of copper and tin employed in the fabrication of bronze objects during the Chou dynasty referred to above, are found in a contemporary work on the industries of the period.

Lacquer has furnished material for one of the earliest industrial arts of the Chinese, but no records of its development from a preservative for woodwork, to its culminating point as a medium for artistic work of the highest order remain. There are three processes in the manufacture of lacquer. The first is the preparation and coloration of the lac, the second, its application by spatula and brush in successive layers never less than three nor more than eighteen, waiting for each layer to dry before the next is put on ; the third, the decoration of the lacquered surface with artistic designs painted with the brush, worked in sensible relief or carved and modelled in the soft ground before it has cooled. This interesting account of Chinese art from the earliest times is fully illustrated.

THE CULTIVATION AND PREPARATION OF PARA RUBBER. By W. H. Johnson, F.L.S., Director of Agriculture, Gold Coast Colony, West Africa. London : Crosby, Lockwood and Son.

In consequence of the insufficiency in the supply of India-rubber to meet the constantly enlarging demands, great attention is being paid to increased cultivation in qualified areas. The author of this book was commissioned by Government in 1902 to visit Ceylon to study the methods employed there in the cultivation and preparation of Para rubber and other agricultural staples for market with a view to introduce them into West Africa. He notes that although the cultivation of Para rubber is at the present time almost limited to a few countries in the Eastern Tropics of the Old World, there is every prospect of its being further extended in those regions and also of being taken up largely in the Western Tropics. There are, he adds, in tropical

Africa thousands of square miles of land suitable for the cultivation of the Para rubber-tree. Upon a large extent of this land rubber-producing plants were at one time abundant, but now year by year their number is being gradually diminished, as the result of the disastrous methods of tapping employed by the native rubber collectors.

It is estimated that the world's annual consumption of rubber is about 60,000 tons, valued at about £16,000,000. In 1830 the amount of rubber imported into the United Kingdom was 460 cwts., and in 1903 it was 486,105 cwts., valued at £6,742,966.

The trees producing Para rubber furnish abont one-third of the world's supply. They belong to the genus *Hevea*. The author remarks that while the demand for rubber continues to increase, the supplies from some sources are steadily decreasing. This is especially the case from different parts of Africa, which furnish a considerable portion of the world's supply,

The rubber prepared from cultivated trees is generally rated at a higher market price than that collected from wild trees in consequence of its greater purity. The loss from "fine" Para is from 10 to 15 per cent. in manufacture, whereas that from the "biscuit" rubber prepared from Para cultivated rubber trees is generally less than 1 per cent. Mr. Johnson has given separate chapters on the cultivation of the tree; insect pests and fungoid diseases (in which he says that no disease has up to the present time been discovered to seriously affect this tree under cultivation); collecting the rubber; preparation of rubber from the latex; yield of Para rubber from cultivated trees; establishment and maintenance of a Para rubber plantation; and the last chapter deals with the commercial value of the oil in Hevea seeds. Here the author states, "In addition to supplying the market with the finest quality of rubber, cultivators of *Hevea brasiliensis* will be in a position to compete in that enormous market which provides the world with vegetable oils."

LABORATORY STUDIES FOR BREWING STUDENTS. By Adrian J. Brown. London: Longmans, Green and Co.

The author of this work, who is the Director of the School of Brewing and Professor of the Biology and Chemistry of Fermentation at the University of Birmingham, finding the want of a suitable text-book, has published the course of laboratory studies which he had proposed for the use of his students. It is intended for the use of students who have already obtained a sufficient knowledge of chemistry, and are attending lectures under a competent instructor.

The first section deals with barley and malting, the anatomy of the barley corn, changes in barley during fermentation, and the chemical analysis of malt. The second section is concerned with the principles of the mashing process, the hydrolysis of starch, analysis of brewing sugars. Section III. is devoted to fermentation, and Section IV. to the hop.

GENERAL NOTES.

GERMAN CEMENT.—In 1852 there was discovered on the coast of the Prussian province of Pomerania the same kind of clay ("Septurien-Thon") used in the United Kingdom in the preparation of cement. This discovery was followed by the establishment ot experimental cement works at Zülchow, near Stettin, where the newly-discovered clay, together with chalk, found in the neighbouring island of Wollin, was used for the manufacture of cement, which was pronounced to be equal in quality to Portland. Thirty years later there existed in Germany 420 factories of cement and cement goods, with a total output of 3,050,000 casks (of 374 lbs. each). In 1895, the annual output had increased to 12,400,000 casks, and the number of cement works to 1,136 larger and 138 smaller factories of cement and cement goods, employing 29,896 persons. No official statistics of the number of cement and other industrial works, and the number of persons employed in different German industries, have been published since 1895, but there can be no doubt that the number of cement works in Germany has largely increased during the last nine years. Sir William Ward, in his Report just published (Diplomatic and Consular Reports No. 624), puts the present output at 30,000,000 casks, or much more than double the quantity produced in 1895. Gradually German cement has become an important article of export from Germany, and it seriously competes with British cement in most foreign countries, and, to a certain extent, even in the United Kingdom itself. But the value of the imports to England is a diminishing quantity, as shown by the following figures, giving the imports for the three years 1901-3:—1901, £58,700; 1902, £50,350; 1903, £45,850. By far the best customer of Germany has been the United States, which in 1902 took cement to the value of £370,000. But in 1903 the value fell to £277,050. Notwithstanding the general growing consumption of cement in the United States the American cement industry is rapidly becoming able to satisfy the home demand. Up to the end of last century the German cement industry was in a very prosperous condition, the average dividend paid by all the larger cement works in 1899 amounting to 17 per cent. In 1900 it fell to 12 per cent., and since then over-production has had disastrous effects.

COTTON GROWING IN THE WEST INDIES.—The efforts made to resuscitate the cotton industry in British Guiana have not yet given results that can be said to be encouraging. The experiments tried, says the Colonial-office report just issued (Cd. 2238), have shown that the soil on the coast-lands of the colony at present under cultivation—a heavy clay—is unsuited for the growth of sea island cotton, and should a suitable variety be found there will remain the labour problem to be faced if the cultivation is to be

undertaken on a large scale. Climatic conditions require that planting shall be done so that the ripening may take place from the latter part of August to the end of November. But in this period the bulk of the sugar and rice crops of the colony are reaped and labour is in good demand. The cost of labour is higher then in the islands, and though cotton was at one time profitably grown in Guiana it remains to be demonstrated whether it can be so grown under present labour conditions. In Trinidad and Tobago, which owe so much in recent years to the cultivation of cocoa, nothing apparently is being done to introduce cotton cultivation. More attention has been given to the question in St. Lucia, but "for a number of reasons," writes Sir George Melville, reporting to Governor Sir R. B. Llewelyn in November (Cd. 2238), "our planters have not seemed disposed to regard the revival of the industry in the colony with favour. One of the difficulties which presented itself was the selection of a variety of cotton to suit the varying conditions of soil in different localities." However, the cultivation is now being more readily taken up, and the efforts of the British Cotton Association may be expected to result in some increase in the area under cultivation, which at present is only about 500 acres.

Dust-Destructors and Electric Lighting.—In his Cantor lectures, in 1892, on the "Development of Electrical Distribution," Professor George Forbes stated that if all the refuse then collected in Paddington were properly burnt and used in the most economical way, it would provide enough electricity to light one 8-candle power lamp for two hours every night of the year for each of the inhabitants. This is referred to in the *Builder*, in connection with a paper read by Mr. W. P. Adams to the Institution of Electrical Engineers, on the question of the combination of dust-destructors with electricity works. We learn from this paper that the results obtained at Hackney and Fulham practically do all that Professor Forbes prophesied, and in a few years even better results will be obtained. Mr. Adams calculates that approximately one million tons of refuse are collected every year in London, most of which is taken out to sea by barges at considerable expense to the ratepayer. On a moderate estimate, the value of the potential capacity of this refuse for steam raising for electric engines is £100,000 per annum. The author shows that, with the improved dust-destructors now in use, there is a substantial gain, in most cases, in combining dust-destructor and electricity works. The exceptional cases are when the refuse has a very low calorific value. At Llandudno and at Royton, in Lancashire, for example, the refuse is of little use for steam raising. It is curious to note that the dust of the greatest calorific value comes from poor neighbourhoods. At Bermondsey its value is particularly high. Mr. Adams suggests that the explanation is that the working-classes, unlike the middle-classes, rarely sift their ashes. In considering the question of dust-destructors, the first point to be settled by municipalities, therefore, is the heating value of the refuse collected. This can be determined experimentally without much difficulty, and the value remains wonderful constant in a given neighbourhood. The revenue earned by a dust-destructor is due mainly to the supply of steam to the electricity works, but this steam can be sold for many other purposes as well.

The London County Council Scholarship Scheme.—In commenting on the County Council Scholarship scheme, then just made known, attention was directed (see *Journal*, December 16th) to a memorandum to the Committee presented by the London Teachers' Association, in which it was said, "the great blot in the whole scheme appears to be the desire to secure candidates for the teaching profession rather than to improve the general education of the children." The County Council reassembles on the 24th, when it will resume the discussion of the scheme, and the signs point to its critics directing their main attack against the attempt to meet the dearth of teachers through the agency of scholarships. That the authors of the scheme wish to use it mainly for this purpose is admitted, for they say in their report, "The total number of scholars selected must be largely increased. This will not really be an increase in the scholarship system as hitherto understood, but is made necessary by the recent Board of Education orders as to pupil teachers." And to this the London County Council Finance Committee adds, "We understand one of the chief ideas underlying the scheme is that it will aid in increasing the supply of adult teachers." It is urged by its opponents that the scheme is too much of a "teacher catching" project, that children from very poor homes could not, under the conditions sought to be imposed, any longer win scholarships, or if they did they cannot benefit by them. "For the great bulk of the children of the artisans," writes Dr. Macnamara, M.P., "we want scholarships that can produce high-grade mechanical, electrical engineering, and business workers. We have too many scholarship-trained clerks already." It will be interesting to have the answer of the framers of the scheme.

Technical and Industrial Education in Bengal.—The latest issue of the *Calcutta Gazette* gives the report of the head of the department on Public Instruction in Bengal for 1903-1904, and after dealing with female education, and the lack of suitable teachers for many classes of schools, the new scheme, which has been drafted for the purpose of improving technical education in the province, is described. Schools are to be established for the purpose of imparting instruction in respect of the best and latest methods of cotton, silk, and wool weaving. It is well known that a great hand-loom industry exists in Bengal. Its condition is, however, precarious; and

it is considered essential, that if it is to be saved from sinking further into decay, really practical technical instruction should be provided for all classes of weavers, except the very small number who are employed in artistic work, to which mechanical improvements are not applicable. The great mass of Indian weavers still use the old Indian hand-loom, and warping apparatus, and are ignorant of the extraordinary mechanical improvements which have been made, since the middle of the eighteenth century, as regards these appliances, and the preparatory processes of weaving. Several of the most important of these improvements are inexpensive and do not require great technical skill, and can easily be adapted to ordinary Indian weaving.

CANADIAN ENGINEERING.—At the conclusion of the address descriptive of the visit of English engineers to America, which Sir William White delivered on Tuesday last to the Institution of Civil Engineers, he said that:—The development of the Dominion of Canada was in an early stage, but those charged with the responsibility of government were fully alive to the grandeur of its resources and its potential greatness. The realisation of this policy depended largely upon the execution of engineering works of enormous magnitude. Those who took part in this visit had but a glimpse of what was being done to utilise the natural advantages of the country, but enough was seen to make it certain that in Canada was to be found a splendid field for British enterprise and capital. Canadian engineers without exception expressed the hope that in the organisation and conduct of the great works now contemplated or to be undertaken hereafter they would have the assistance of British engineers and especially of young engineers. No better school for aspirants in the profession could be found than that afforded by the Dominion. What was true of Canada was true also of our other Colonies and Dependencies, and it might be hoped that British enterprise and capital would be more devoted in the future to the development of the resources of the British Empire, and less to corresponding work in foreign countries.

CANAL BOAT CHILDREN.—The report of the Board of Education for the year 1903-4 contains the following information respecting the education of canal boat children:—"The conditions of school attendance in the case of children living in canal boats remain very much as they have been in previous years. The effective enforcement of the Education Acts as concerns these children is necessarily difficult. Although the various school boards and school attendance committees appear to have discharged their duties so far as circumstances permitted, the result was, and must always be, unsatisfactory owing to the facts that the boats are constantly moving from one town to another, and that many boats rarely, if ever, revisit their place of registration. Possibly the difficulty will be in part remedied by the wider authority of the county councils under the Acts of 1902 and 1903. As in previous years, several authorities urge that it should be made illegal for children under fourteen years of age to reside on canal boats. It is, however, satisfactory to find that in most districts it is becoming unusual for either women or children to live permanently on the boats. We hope that the boat owners may be induced generally, as they have already been in some cases, to co-operate by forbidding their workmen to take their families with them."

WATER POWER FOR IRON ORE SMELTING IN CANADA.—In the *Journal* of December 9th, the report of the Canadian Commission on the electrothermic manufacture of iron and steel was reviewed, and mention made of Dr. Haanel's citation of the Chats Falls, near Ottawa, as offering exceptional facilities for the generation of cheap power. These falls are situated on the Chats River, and are 28 miles west of Ottawa. At low water the available head is 41 feet, and the minimum flow 1,200,000 cubic feet per minute. At high water the maximum flow exceeds 7,500,000 cubic feet per minute. The Canadian Government has under consideration a proposal for damming up the lakes so as to give a mean minimum flow of 2,500,000 cubic feet per minute. This would give 170,000 horse-power, if used for generating electricity. It is stated that the natural facilities are such that the power can be developed at an unusually low capital cost. It is hoped that a direct and immediate result of the report of the Commission will be the erection of works for the electrical reduction of iron ore. The plant initially contemplated would be one of 18,000 horse-power, of which 16,000 horsepower would be used for smelting the ore, the remainder being used for power and lighting.

THE COST OF JUSTICE.—A return relating to the High Court of Justice and the Court of Appeal, just issued, gives the cost of these Courts to the country for the year ended 31st March, 1904. The total receipts amounted to £508,121 13s., the total expenditure to £622,877 4s. 6d., leaving a deficit of £114,755 11s. 6d. The largest item under the head of receipts is "fees received in the district registries of the High Court," £21,286 0s. 8d., and the next, "Lunacy percentage account fees," £16,284. The salaries of the Judges, including that of the Lord Chancellor (£6,000) amounted to £155,000, and £22,949 14s. 7d. was paid on account of retiring annuities of Judges. The circuit expenses of the Judges came to £11,261 12s.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 18.—"Wireless Telegraphy and War Correspondence." By CAPTAIN LIONEL JAMES. SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., will preside.

JANUARY 25.—"London Electric Railways." By the HON. ROBERT P. PORTER.

FEBRUARY 1.—"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S. SIR ROBERT HANBURY BROWN, K.C.M.G., will preside.

FEBRUARY 8.—"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY. GEORGE DAVISON will preside.

FEBRUARY 15—

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

Dates to be hereafter announced:—

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTON.

"Application of Electricity to the Location of Mineral Deposits." By ALFRED WILLIAMS.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 19.—"The Gates of Tibet." By DOUGLAS W. FRESHFIELD. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

APRIL 6.—

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

JANUARY 24.—"British Commercial Prospects in the Far East." By BYRON BRENAN, C.M.G., late H.B.M. Consul-General at Shanghai. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILY HEWITT. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials." By MARION H. SPIELMANN. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR LALIQUE (Paris).

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic, and Fountain Pens." Three Lectures.

LECTURE I.—JANUARY 23.—*Ancient Writing Implements.*—The Stylus and Tabula—Calamus or reed pen—Stencil—Quills, quill nibs, attempts to make quills more serviceable—Substitutes for quills—Silver pens—Ink horn and penner—Ancient writing outfit—Eastern writing implements—Survival of ink horn—Japanese writing box and pens—Their portable writing set—Early metal pens—Steel pens—Barrel pens—First patent for metallic pens—Improvements in steel pens with the object of increasing their ink-holding capacity—Reservoir nibs, various illustrations.

LECTURE II.—JANUARY 30.—*Stylographic Pens.*—Rudimentary forms—Early patents—Rigid points, needle points—Various writing or marking pens—Modern Stylographic pens, Nota Bene, Cygnet, and others—Gold pens, description of manufacture.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements—Self-filling, reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HERBERT LAWS WEBB, "Telephony." Four Lectures.
March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.
May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.
May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 16...Optical, 20, Hanover-square, W., 8 p.m. Messrs. S. D. Chalmers and H. S. Ryland, "A Method of Testing Prisms."

Surveyors, 12, Great George-street, S.W., 8 p.m. 1. Mr. A. R. Stenning, "Urban and Rural District By-Laws, with Suggested Amendments." 2. Mr. William Menzies, on the same subject.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Victoria Institute, 8 Adelphi-terrace, W.C., 4½ p.m. Colonel T. Holbein Hendley, "The History of Rajputana."

London Institution, Finsbury-circus, E.C., 5 p.m. Dr. W. Evans Darby, "The History of International Arbitration."

TUESDAY, JAN. 17...Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Mayall, "Adaptation and History in the Structure and Life of Animals." (Lecture I.)

National Service League, Caxton-hall, Westminster, S.W., 5½ p.m. Mr. G. G. Coulton, "The Moral and Educational Advantages of Universal Naval and Military Training."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Leveson Francis Vernon-Harcourt, "The River Hooghly."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Reginald Dudfield, "A Critical Examination of the Methods of Recording and Publishing Statistical Data bearing on Public Health, with Suggestions for the Improvement of such Methods."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. W. F. Lanchester, "A Collection of Sipunculids made at Singapore and Malacca." 2. Mr. W. F. Lanchester, "A Collection of *Gephyrea* from Zanzibar." 3. Mr. W. F. Lanchester, "The Sipunculids and Echiurids collected during the 'Skeat Expedition' to the Malay Peninsula." 4. Mr. A. D. Imms, "The Oral and Pharyngeal Denticles of Elasmobranchs." 5. Mr. F. E. Beddard, "A Contribution to the Anatomy of *Chlamydosaurus* and some other *Agamidæ*." 6. Mr. F. E. Beddard, "A Note on the Brain of *Cynopithecus niger*."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. E. A. S. Harney, "Imperialism from an Australian Standpoint."

WEDNESDAY, JAN. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Captain Lionel James, "Wireless Telegraphy and War Correspondence."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Annual General Meeting. Address by the President (Captain D. Wilson-Barker), "The Connection of Meteorology with other Sciences."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Annual Meeting. Address by the President, "What were the Carboniferous Ferns?"

Chemical, Burlington-house, W 5½ p.m. 1. Mr. F. D. Chattaway, "Nitrogen Halogen Derivatives of the Sulphonamides. Part I.—Sulphondichloroamides and Sulphonalkylchloroamides." Part II.—"Sulphondibromoamides and Sulphonalkylbromoamides." 2. Mr. H. D. Law, "Electrolytic Oxidation of Aliphatic Aldehydes." 3. Messrs. G. T. Morgan and F. M. G. Micklethwait, "The Diazo-derivatives of the Benzenesulphonylphenylenediamines." 4. Messrs. S. E. Sheppard and C. E. K. Mees, "The Molecular Condition in Solution of Ferrous Potassium Oxalate." 5. Mr. W. C. Anderson, "The Formation of Magnesia from Magnesium Carbonate by Heat, and the effect of Temperature on the Properties of the Product." 6. Mr. K. J. P. Orton, "Transformations of Derivatives of s-tribromodiazobenzene." 7. Mr. A. W. Stewart, "The Addition of Sodium Bisulphite to Ketonic Compounds."

Entomological, 11, Chandos-street, W., 8 p.m. Annual Meeting. Address by the President, Professor E. B. Boulton.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Society of Dyers and Colourists, 608, Birkbeck Bank Chambers, W.C., 8 p.m. 1. Mr. F. J. Farrell, "Production of Crepon Effects on Silk Fabrics by Chemical Means." 2. Mr. Fredk. Hewitt, "The Dyer: His Trade and Position."

THURSDAY, JAN. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Douglas W. Freshfield, "The Gates of Tibet."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Rev. T. R. R. Stebbing, "Exhibition of Specimens of notable and little-known Crustaceans, chiefly exotic." 2. Dr. A. Henry, "Botanical Collecting." 3. Dr. W. G. Ridewood, "The Cranial Osteology of the Families Osteoglossidæ, Pantodontidæ, and Phractolæmidæ."

London Institution, Finsbury-circus, E.C., 6 p.m. Dr. E. Markham Lee, "Dvorak."

Royal Institution, Albemarle-street, W., 5 p.m. Mr. Churton Collins, "The Religion of Shakespeare."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Dr. J. A. Ewing, "The Structure of Metals."

FRIDAY, JAN. 20...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m., Prof. Sir James Dewar, "New Low Temperature Phenomena."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Mr. A. J. Gimson, "Some Impressions of American Workshops." 2. Mr. John Barr, "Waterworks Pumping Engines in the United States and Canada." 3. Mr. Archibald Kenrick, Jun., "Some Features in the Design and Construction of American Planing Machines." 4. Mr. Alfred Saxon, "Engines at the Power Stations, and at the St. Louis Exhibition."

SATURDAY, JAN. 21...Royal Institution, Albemarle-street, W., 3 p.m.

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FRIDAY, JANUARY 20, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 23, 8 p.m. (Cantor Lecture.) JAMES P. MAGINNIS, "Reservoir, Stylographic and Fountain Pens." Lecture I.

TUESDAY, JANUARY 24, 4.30 p.m. (Colonial Section.) C. F. JUST, "The Manufactures of Greater Britain.—I. Canada."

WEDNESDAY, JANUARY 25, 8 p.m. (Ordinary Meeting.) The HON. ROBERT P. PORTER, "London Electric Railways."

Further details of the Society's meetings will be found at the end of this number.

INDIAN SECTION.

Thursday afternoon, January 19th; Sir WILLIAM LEE-WARNER, K.C.S.I., in the chair.

The paper read was "The Gates of Tibet," by DOUGLAS W. FRESHFIELD.

The paper and report of the discussion will be published in a future number of the *Journal*.

PORTRAIT OF SIR F. BRAMWELL.

With this number of the *Journal* is issued, as a Supplement, a reproduction of the portrait of the late Sir Frederick Bramwell, by Mr. Seymour Lucas, R.A., which was presented to the Society by Mr. Henry Graham Harris last November, and now hangs in the Council Room. (See *ante*, November 25, 1904, p. 19.)

A small number of extra copies of the portrait have been printed, and a member wishing to bind the portrait with the *Journal* can have a copy on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

SIXTH ORDINARY MEETING.

Wednesday, January 18th, 1905; Sir WILLIAM HENRY PREECE, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Abrams, Herbert John Sinclair, Hutton Mount, Pattison-road, Child's-hill, N.W.
Adams, Alfred Adam, 16 and 17, Devonshire-square, E.C.
Bevan, William, A.R.I.B.A., Chief Government Architect, Public Works Department (P.O. Box 398), Government Buildings, Pretoria, South Africa.
Erikson, Anthony, Assoc.I.N.A., 20, Hummum-street, Fort, Bombay, India.
Evans, Captain Thomas Luther, 59, Broad-street, Bristol.
Fernandez, George Anthony, 43, Raffle's-place, Singapore, Straits Settlements.
Frick, Henry Edgeworth, care of Fore River Shipbuilding Company, Quincy, Massachusetts, U.S.A.
Harwin, Albert Edward, Church-street, Pietermaritzburg, Natal, South Africa.
Hoare, Frederick, 251-254, High Holborn, W.C.
Hynd, John, Consolidated Goldfields of South Africa, Ltd. (Box 67), Bulawayo, Rhodesia, South Africa.
Kelly, John Forrest, Ph.D., Pittsfield, Massachusetts, U.S.A.
Kerr, David Gillespie, The Canada Corundum Company, Ltd., Craigmont, Ontario, Canada.
Khras, Minocher Jamshed Sohrab, Khras Bungalow, Middle Colaba, Bombay, India.
Kingston, C. Burrard, M.Inst.M.M., The Evancon Gold Mining Company, Ltd., Verrés, Val d'Aosta, Italy.
Landau, Miss Dorothea, 30, Bryanston-square, W.
Legardo, Vicente L., 208, Mason street, San Francisco, California, U.S.A.
Morris, Rev. E. C., D.D., Ph.D., Helena, Arkansas, U.S.A.
Morrison, Charles, 53, Coleman-street, E.C.

Muir, David Temple, Pentlands, Castlebar-road, Ealing, W.
Oliveri, Joseph Giammusso, A.R.S.M., A.I.E.E., Caltanissetta, Sicily.
Pain, Robert Tucker, J.P., Ryll-court, Exmouth.
Pollock, George Frederick, Hanworth, Middlesex.
Reid, William Lewis, 160, Green-lanes, Clissold-park, N.
Roberts, Cyril, 1, Rossetti Studios, Flood-street, Chelsea, S.W.
Roberts, Richard Penberth, M.Inst.MM., Concession de Tama, Vezzani, Corsica, France.
Robertson, James Barr, The Oriental Club, Hanover-square, W.
Schäfer, Henry Thomas, 40, Brewer-street, Golden-square, W.
Suratwâllá, Dr. Ardeshir Bamanjee, Chira Bazar, Bombay, India.
Thomas, Hon. J. J., M.L.C., J.P., Wilberforce-house, Sierra Leone, West Africa.
Trevett, Charles G., A.M.I.E.E., Messrs. Green and Trevett, 15, Castle-street, Cape Town, South Africa.
Tully, John Collingwood, F.R.I.B.A., Ardernes-chambers, Longmarket-street, Cape Town, South Africa.
Wecksley, Felix S., Bangalore, India.
Wedlake, George, Royston, St. Margaret-at-Cliffe, Kent.
Wright, Allister MacLean, 62, Harman-street, Addington, Christchurch, New Zealand.

The following candidates were balloted for and duly elected members of the Society:—

Dale, Hylton William, 8, Chalcot-gardens, Belsize-park, N.W.
Ertz, Edward Frederick, R.B.A., Polperro, Cornwall.
Fletcher-Watson, P., R.B.A., Ashleigh, Paignton, South Devon.
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The paper read was—

WIRELESS TELEGRAPHY AND WAR CORRESPONDENCE.

By Captain Lionel James.

It is with considerable diffidence that I presume to address you this evening upon a subject of which I have no scientific knowledge. But Sir William Preece has been kind enough to encourage me in the belief that you will be indulgent if during the evening I make slips or miscalculations which may offend the sensitiveness of your expert ears. I may preface my remarks by saying that I know nothing at all about wireless telegraphy But during the early months of last year, as a humble servant of *The Times*, I was entrusted with the carrying out of a scheme in which wireless telegraphy played an important part. Therefore you must not expect me to do more than tell you, how, when my expert advisers gave me guarantees with regard to conditions and distances, I was able to apply the scientific apparatus for which they were responsible, to the needs and necessities of *The Times* newspaper. For six months a portion of *The Times* correspondence found its way to the London office by the means of wireless telegraphy, and, to use a perhaps not inadequate simile, during this period as far as the wireless service was concerned, Dr. de Forest supplied the drawing, while I was responsible for the frame.

Five years ago I commenced to take an interest in the results which were being attained by wireless telegraphy, for it seemed certain that, sooner or later, occasion would arrive when it would be practicable to apply to journalistic enterprise this marvellous adjunct to the world's system of communication. The war correspondent is not usually modest, and we have seen many accounts of the ingenuity which members of this small craft have employed to enable their journals to publish, in as short a time as possible after the event, a graphic account of some sensational episode. Although I belong to the young school of correspondents, even within my small experience I have seen the employment of cut-throat Pathans, Ethiopians, bicycles, pigeons, camels, horses, skin-floats, heliographs, bottles, field telegraph wires, boats, flags, &c., as a means of hastening news to the correspondent's essential, the submarine cable. Some of these endeavours necessitated great expense, others considerable personal sacrifice. Therefore there had always remained at the back of my mind an idea that much of the labour, much of the risk and loss, and not least, perhaps, much of the personal discomfort might be avoided by the use of the scientific progress made in the experiments with the Hertzian waves. The fact that I had entered upon my profession during a cycle which found me in constant active employment prevented me from making as close a study of these scientific results as I might have desired; it did not, however, prevent me from attempting a comparison in the results obtained. The

recital of a journey to the Isle of Wight, of three days spent in following a German military wireless telegraphy waggon, of conversation with torpedo lieutenants in the British navy, of a voyage to America when most of my leisure was passed in the wireless chamber of the liner, would be wearisome. It was not until I saw evidences of the success which Dr. de Forest had attained in the field of American Press rivalry during the yacht races in the summer of 1903 that I realised that the time would soon be at hand to present a feasible scheme to my employers.

Our old friend the Balkans claimed my presence when Dr. de Forest was carrying out his experiments between Holyhead and Ireland the year before last. But by great good fortune the mail steamer, which a month later was taking Dr. de Forest back to his labours in the United States, also carried me and my capable colleague, Mr. David Fraser, towards the war cloud gathering in the Far East. This fortunate meeting enabled me to discuss the minute detail with regard to the application of his system to the purposes in hand. The department in *The Times* office which deals with war, and naval and military subjects, had, when I was present at their last meeting, the evening before sailing to the Far East, forecast with great accuracy the area which would cover the most important of the early land and sea operations. If you will follow me a moment on this chart of the Yellow Sea and the Gulf of Pe-chili (p. 207), you will see at once of what value a moving station would be to us if equipped with wireless telegraphy. It is the avowed intention of the de Forest Company, at least, so I understand, to act, not as the rival of the cable companies, but as the auxiliary. And this was the use for which *The Times* desired wireless telegraphy—to act as an auxiliary to its cable service. You will see that in making a choice of a receiving station I had to consider the distances that it would be necessary to cover in reaching the cables. The Shangtung province at once suggests itself. Here we have two cable stations, namely, Wei-hai-wei and Chifu. For reasons which I think are obvious to all of you in this room I selected Wei-hai-wei. Dr. de Forest promised me that if I succeeded in erecting a mast 180 feet in height on the China coast and used it in conjunction with a moveable station which showed an exposure of at least 120 feet of wire, that he would supply me with a set of apparatus and expert operators who would transmit messages with accuracy for 160 miles. At New York I was able to place this proposition before my employers. I need not tell you that *The Times* has always given its great support to all matters of scientific research and experiment. After due consideration of the scheme they authorised me to make the necessary arrangements for carrying it into practice.

As you are all aware, events in the Far East during January last year were moving rapidly towards war. Therefore every despatch had to be made in order that we might be in time for the opening of the campaign. I left San Francisco for Yokohama on the 5th of January, and a fortnight later the de Forest Company had started off after me a complete apparatus for two stations with the necessary complement of expert operators.

On arriving in Japan, my colleague, Mr. Fraser, was without delay despatched to Wei-hai-wei to commence the building of the receiving station. It is interesting to notice here that he caught the last steamer which sailed from Fusan to Chifu before the passenger service in the Yellow Sea between Japan, Korea, and China became disorganised.

On the Pacific liner we had talked airily of constructing a receiving station that would give us a 180 feet exposure of wire. Nautical men told us it was as simple as falling off a log. Engineers with a knowledge of China advised us to build a bamboo structure, which they said any Chinese contractor would raise in a few days. It is one thing to run up a mast when you have every appliance within reach or to build a bamboo structure in a Treaty port where Chinese contractors are falling over each other, but it is a very different thing, as Mr. Fraser found, to construct a receiving station on a bleak island off the coast of China when little or nothing in the way of appliances is at hand.

I will not weary you here by giving you a minute description of the troubles which we had with that mast. All the essentials had to be brought up from Shanghai several hundred miles by sea. Once it fell and broke to pieces, another time it was blown down by a typhoon, and as for the bamboo structure of which Chinese residents had spoken so much, we found that there were no contractors falling over each other in the desire to do our bidding, and also that the Chinese were not in the habit of building these structures in the Shan-tung province. If I had realised the many diffi-

culties which surrounded us I am not sure that I would have been bold enough to have suggested the enterprise.

As may be readily understood the Japanese naval and military authorities looked upon the enterprise with some suspicion. They were at least far more courteous than their enemies who promised us short shrift if they should catch us. But the latter was a minor difficulty in comparison with the trouble of that mast and the handling of a 1,400-ton steamer, to say nothing of a delicate installation, which requires to be coquetted with and humoured in every weather, condition, and season.

Hostilities broke out on February 6th. The belligerents had not been considerate enough to wait for us. On February 8th the steamer containing operators and apparatus arrived at Yokohama. I had *The Times* despatch boat, the *Haimun*, waiting for this liner at Shanghai. During her wait here she had been fitted with the necessary spars to enable her to give the required exposure of wire. She left Shanghai on February 16th, the operators, as far as the weather would allow, busying themselves in commencing to fit her with the transmitting apparatus. On February 17th the *Haimun* arrived at Wei-hai-wei, and the operators were placed on shore, in order to get the receiving office in order while the *Haimun* commenced to ply between Wei-hai-wei and Chemulpo in her capacity of despatch boat. It may be mentioned here that six hours after the *Haimun* left Shanghai the whole of the wireless fixings which had been put up there were carried away by a gale of wind.

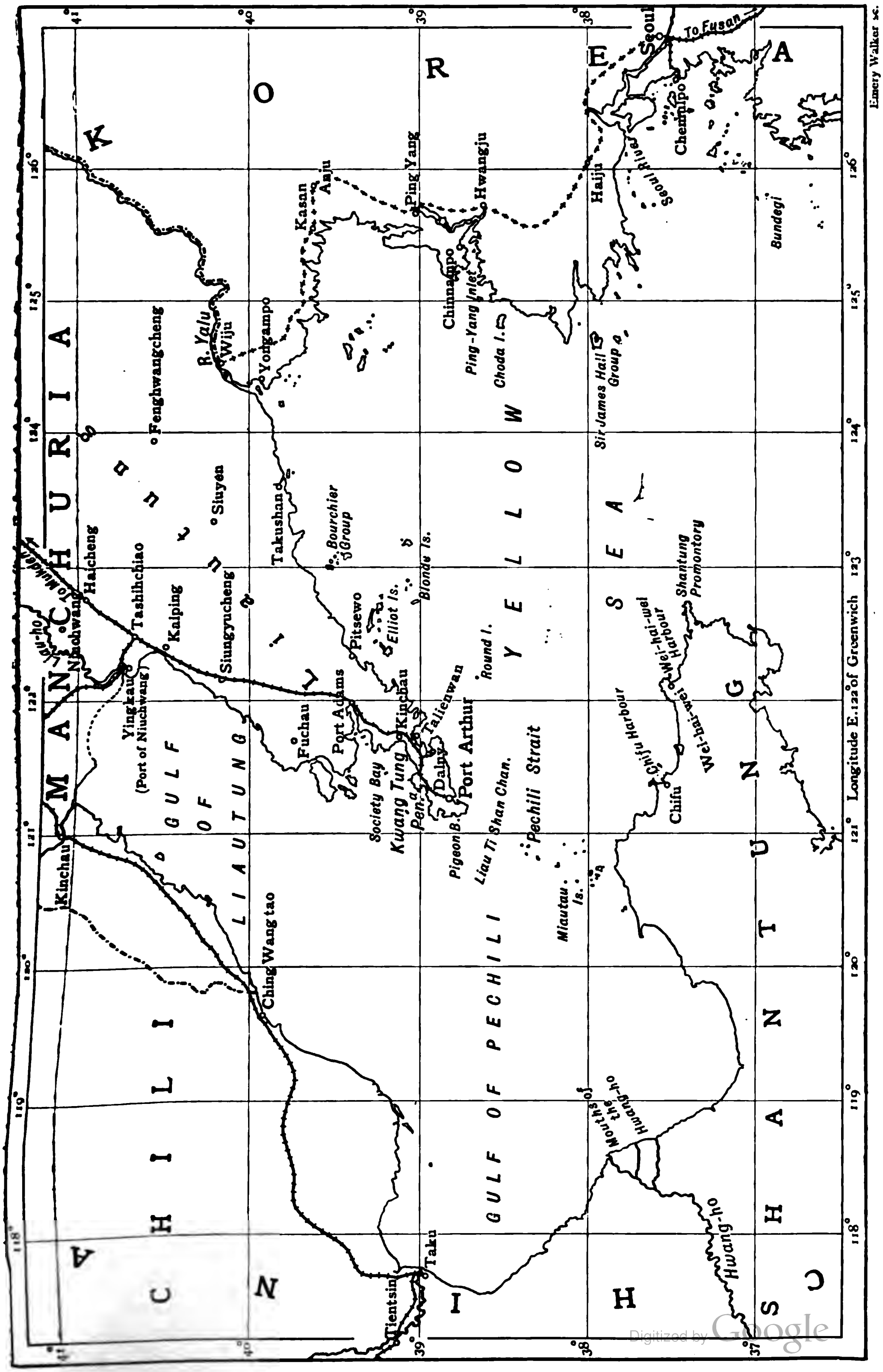
Until the end of February the operators who were also expert mechanics were hard at work in getting the station into working order. I may point out that Dr. de Forest had told me that in the United States where every appliance was to hand, they required three weeks at least to bring a station into working order. Therefore, as the apparatus only arrived at Wei-hai-wei on February 17th, we could hardly expect to have the system working before March 15th. But even in spite of the fact that a part of the machinery had miscarried during transhipment, we were able to despatch our first message from sea 50 miles outside Wei-hai-wei on March 14th.

I must here mention that although we had guaranteed to give Dr. de Forest a shore station with 180 feet exposure and 120 feet on the moving station, yet with the appliances at hand we were never able to raise more than 165 on the shore station and 105 on the boat. Therefore it was with some misgivings that we entered as a working machine. The first message that we had sent had been purely experimental, and it was not until two days later that we were able to give the system a fair chance.

We had cleared for Chenampo, in which port the ice had broken up sufficiently to allow Kuroki's army to commence landing. It was a bitterly cold journey, and when we entered the Ping-yang Inlet we had to forge our way through several miles of floating ice. We steamed up, and anchored in the middle of the Japanese transport fleet.

On the morning of the 17th we left Chenampo with valuable and exclusive information both with regard to the Japanese landing, the situation of the Russian forces on the Yalu, and of General Inouye's terrible march up from Seoul to Ping-yang. On the advice of the expert operator on the *Haimun* we did not attempt to send a message to Wei-hai-wei until we were eighty miles from our receiving station. At this distance a message was sent, and as we received no acknowledgment we steamed in and repeated the message at fifty-five miles. Then, as no acknowledgment was received, and we felt that something was wrong, we continued the journey to Wei-hai-wei. Here we found that not only had the second message been received in its entirety but that the first came in without a mistake, and before a duplicate had been sent in, was on the cables and on its way to London. It would be hard to express the relief which we felt at this result. Up to that moment there had been something of a speculative nature about the whole enterprise. And those of us who were responsible, as chapter of accident succeeded chapter of accident, could not fail to suffer from some feeling of depression. But here in the very first instance had been a success. With our but half-adjusted station we had succeeded in covering a distance of which, in their own service, the British Navy speak with pride, and which a Japanese naval expert gave me as the outside limit of the system employed in the Imperial Japanese Navy. The fact that, although our shore station was able to receive, yet it failed as a remitting station, was not only an inconvenience but a distinct flaw. But the chief expert of the de Forest Company said that if I gave him a day he would rectify this.

Although we had chosen a point for our shore station, namely, Leu-kung-tau, the


MANCHURIA
KOREA
CHIHLI
SHANTUNG
YELLOW SEA
GULF OF PECHILI
GULF OF LIAUTUNG
Pechili Strait
Seoul
To Fusan
Chemulpo
Seoul River
Haiju
Hwangju
Ping Yang
Chinnampo
Ping-Yang Inlet
Choda I.
Sir James Hall Group
Anju
Kasan
Yongampo
Wiju
R. Yalu
Fenghwangcheng
Siuyen
Takushan
Bourchier Group
Blonde Is.
Elliot Is.
Pitsewo
Haicheng
Tashihchiao
Kaiping
Siungyucheng
Niuchwang
Liau-ho
To Mukden
Yingkau (Port of Niuchwang)
Fuchau
Port Adams
Kinchau
Talienwan
Dalny
Port Arthur
Round I.
Society Bay
Kwang Tung Pen.a
Pigeon B.
Liau Ti Shan Chan.
Miautau Is.
Chifu Harbour
Chifu
Wei-hai-wei Harbour
Wei-hai-wei
Shantung Promontory
Bundegi
Kinchau
Ching Wang tao
Mouths of the Hwang-ho
Hwang-ho
Taku
Tientsin
Longitude E. 122° of Greenwich
Emery Walker sc.

island at the mouth of the bay at Wei-hai-wei harbour (which gave us a clear arc of open sea of about 135 degrees), yet of necessity we had been obliged to erect a station some 300 feet above the sea level. This, as the scientists among you will know, was a distinct disadvantage, but the expert operator nullified this discrepancy by placing copper plates in the sea and connecting them to the station. After he had done this we had no difficulty in receiving from the station, though owing to the fact that our exposure of wire was nearly 50 feet less on the transmitting station than on the receiving station, we were never able to receive at quite the same length of distance as we were able to transmit.

We had now our system working and it only remained for us to develop it, as far as its limitations would allow, to its full uses for journalistic reporting. The operators were confident that we should be able to cover one hundred miles, and, at that period, being quite ignorant as to the distance we should eventually succeed in bridging, we were prepared to rest content. As you will remember the inability of the Russian fleet to remove itself from the magnet of Port Arthur had placed the sea operations within an area which was practically limited by Port Arthur on the west and the Sir James Hall's group (Admiral Togo's rendezvous) on the east. Our receiving station was just 90 miles from Port Arthur and 125 from the Japanese advance naval base. It, therefore, behoved us to enter the arena and trust to luck and our own acumen to be present at such stirring events as this arena might unfold. My Japanese interpreter quoted a proverb to suit our case. This Japanese adage runs, "It is the wandering dog that finds the bone." We undertook the *rôle* of the wandering dog, and fortune so favoured us that we found several bones. A spell of very fair weather had set in on the Yellow Sea so we determined to hover about Port Arthur in the hope that we might witness a fleet action.

As between the dates of March 21st and April 16th, we were constantly in the thick of stirring events, and as the object of this paper is not to describe naval operations, but to place before you some of the results which we obtained through the de Forest wireless system, I will not enter into a detailed narrative of our movements, but will endeavour to narrate a few of the more striking journalistic results which we obtained by the means of wireless telegraphy. But before this I must record another mishap. Just as the mast of the receiving station was beginning to do good work, the top-gallant mast was carried away, and until this was repaired we were reduced to a 90 feet exposure. As we estimated that it would take three days to re-rig the top mast and the top-gallant mast, our first course was made in the direction of Port Arthur. At this period it was believed that, as a result of the first Japanese blockading operations, the Russian squadron was immured within Port Arthur.

The *Haimun* arrived off Port Arthur about mid-day. We were not steering directly upon the Port, but stood upon a course which would have taken us through the Liau-ti-shan channel to Taku. As we neared the Miantau group, we noticed a great belt of smoke beyond the islands. Soon we distinctly made out warships, and for the moment, believing the general report that Admiral Makaroff was immured within his base, we imagined that they were Japanese. However, we were soon near enough to count the smokestacks and with the aid of naval pocket books to recognise three battleships and two cruisers belonging to the Russian fleet. We were about 75 miles from Wei-hai-wei, and a report as to the strength, course, &c., of the Russians was immediately despatched to London. Altering our course so as to avoid coming too near to the Russian ships, we stood on under the Miantau group until dark, and then steered a course due West. About ten o'clock in the evening we were in the middle of a torpedo flotilla, which was proceeding to Port Arthur, taking with it a further number of merchantmen to be sunk in the entrance. By this the Japanese seemed to know all about us, they took no notice of the *Haimun*, and we followed them in the direction of the attack, and were able on the following morning to report the incident direct to London before Japan knew that the attempt had been made. As the attack took place in the dark, it was, of course, impossible to furnish the newspaper with details, but these we obtained within twenty-four hours by a visit to one of the Japanese bases. On this occasion we sent the really first long message that has ever been sent to a journal by means of wireless telegraphy over any considerable distance.

I should have said that in the meantime, although we had not visited our base, we had heard from Wei-hai-wei that our new mast was complete with a 165-foot

exposure of wire. We therefore determined to give the system a real trial. We commenced to send the message, which was 1,500 words in length, from 130 miles. The message was sent in four sections of 350 words each. At the end of the first section the operator on the ship listened in for a reply. All excitement, I was waiting in the chamber to see if there was any result. For about five minutes the operator remained with the telephonic receivers glued to his ears. Then I saw a light gleam in his eyes, he was getting something. At last he took off the telephone and said in his quiet, quaint American way, "Captain, we will deliver the goods, Wei-hai-wei says that it is coming in like a drum." The remaining sections were sent at once at the rate of thirty words a minute, and although we took the precaution to repeat each section, yet we might have saved ourselves the trouble, since on my return to Wei-hai-wei I compared my written message with the message that was handed in at the Eastern Cable extension, and I assure you there was not one word that had been taken wrongly.

From the moment that we realised that we were safe at 125 miles, and mind you, this is sea miles, we felt positive that the system was a complete success. If there are any who doubt it, I can only refer them to the columns of *The Times*, which had at this period exclusive information for its readers at first hand, from a theatre of operations that was beyond the reach of any other correspondent then following the fortunes of Russia or Japan in the Far East. By the instrumentality of wireless telegraphy used as an auxiliary to the cable service, *The Times* practically had the field of first hand information to itself.

The success which we had obtained, so far encouraged us that we determined to give the system a really big trial as soon as the course of the campaign should carry us a greater distance from our receiving station. It had been arranged in Tokio that my lieutenant, Mr. David Fraser, should accompany Kuroki's army in the field. The other correspondents associated with this particular force had left Japan, under the guidance of the Japanese. My instructions had also reached me from Wei-hai-wei by wireless telegraphy, telling me that it would be necessary to make the journey to Chemulpo, in order that Mr. Fraser might join the other correspondents at that port. The run to Chemulpo from Wei-hai-wei is about two hundred and fifty sea miles. Owing to weather and fog we had miscalculated and had to anchor at the entrance of the Seoul archipelago. We anchored off the island of Bundegi, which you will see from the chart is 180 sea miles from the point of Lieu-kung-tau, where our receiving station stood. We despatched a message from this island and received a reply at once. On the following day when we were returning from Chemulpo with the intention of going north to Chinampo, we sent from the vicinity of Bundegi a third long message, the aggregate of which was nearly 2,000 words. The whole of this communication was successfully received and appeared on the following morning in the columns of *The Times*.

I think that I have told you sufficient to show that we were justified in the confidence which we had placed in Dr. de Forest's assurances, but I will not close this short record of our successes without making reference to what I consider the great journalistic triumph of the war so far as the sea fighting is concerned. Mr. Fraser had missed his connection at Chemulpo and it was, therefore, necessary that we should land him with all expedition at Chinampo. By means which it is not necessary to disclose in this paper, I obtained information which showed me that I had the narrowest margin in which to visit Chinampo if I did not wish to miss important operations pending in front of Port Arthur. We bundled Mr. Fraser and his ponies and equipment on shore, and left that dangerous harbour on the night of April 12th. We had just time to make Round Island by daybreak if we went full speed. It was an occasion for burning coal; it was shovelled in, and with the help of a current we were doing fifteen knots.

As this incident was somewhat dramatic, I will read you an extract from a description written at the time :—

We anchored off Chinampo at 11 o'clock in the morning. During our passage from Chemulpo to Chinampo we had passed in the night the entrance to the base Togo was then using. What we had seen in passing had given us an idea that we had no right to be remaining in Chinampo when the place for our vessel should be off Port Arthur as soon as possible. Therefore, we lost no time in discharging *The Times* correspondent, with his baggage and his ponies. But only those who have been at Chinampo during this period of military activity can know the difficulty of landing operations. Fortunately, we were given some assistance by the authorities, and by 3 o'clock the last of the animals was off the *Haimun*. Now the navigation in and out of Ping-yang Inlet is extremely difficult at all times. The channels are very intricate and shoal, and it is impossible for

a skipper without a pilot to get clear of the islands in the dark. Moreover, a very heavy tide runs. We had 55 miles to go before we could clear and only four hours of daylight. My skipper was doubtful if he would be able to take the ship out, but he said he would try if we could prevail upon the engineer to do his best. I put it to both officers that it was a case in which we had five minutes to decide whether or not we should see possibly the greatest naval encounter of the war. Both men said they would do their best. By a merciful Providence we had the tide with us, and shovelling the coal in we made a pace against time down the inlet which I am positive no merchant steamer has ever made before. With the boilers doing their best we could knock 14 knots out of the *Haimun*. With a four-knot tide with us we may safely say we steamed out of the inlet at nearly 17 knots. It began to rain, and clouds of mist made the skipper look serious, because it was a passage in which one dare not lose one's landmarks, but he set his teeth and fulfilled his promise to do his best. Just in one of the narrow channels we had a scare. Suddenly the engines stopped. I think that in the whole of my experience perhaps this was the unhappiest moment. I knew a great deal more than any one else in the ship what it meant to us to be outside the entrance that night, and here, just as I was congratulating myself that we should be able to make the open sea, the engines stopped suddenly. I dashed down to the engine-room to find the chief engineer, not with the grave face I had expected, but with a smile. "It is nothing," he said, "only if I had continued without stopping her it might have ruined the whole show. It will be all right again in five minutes, but we had got one of the bearings screwed down too tight and it was heating, and therefore I stopped her to loosen it. She's going fine. We will get out all right," and so it proved. Again the bell rang, and again the propeller revolved, and we were making our course into the fairway. In spite of the heavy bank of clouds, and in spite of the heavy mist and the rain, the captain kept her going, and just as night dropped her final curtain we were clear of the shoals. It had been touch and go, and another quarter of an hour's delay, or the tide against us, would have caused us to miss the sinking of the *Petropavlovsk*. The effort had not been in vain, for, although we ploughed through the dirtiest weather imaginable that night, at daybreak we found ourselves abreast of Togo's battleship squadron. The rest of the story has already been told in the columns of *The Times*.

Just as day was breaking, the chief officer on the *Haimun* woke me to say that the Japanese fleet was on our starboard beam. We had hit it off exactly, and keeping abreast of Togo's squadron, we witnessed the operations which cost the Russian cause a first-class battleship and Admiral Makaroff. We saw most of the operations, and when the Japanese battle squadron hoisted its fighting flags and steamed in to engage the fortress, as the flagship, the *Mikasa*, fired her first 12-inch gun, my operator despatched my brief message announcing the fact to Wei-hai-wei. That message was sent at express rate, and consequently was in *The Times* office a couple of hours later, and making allowances for the difference of time, the newspaper office knew that an engagement was taking place six hours before that engagement began. The full descriptive details of this action, which were contained in a message of nearly 2,000 words, were sent correctly from Choda Island, 145 sea miles frm the receiving station.

I think that with these instances I have quoted sufficient to show, not only the excellence of the de Forest system, but enough to convince you that imperfect as I believe the full development of wireless communication to be, yet in its present form, as handled by Dr. de Forest, it has sufficiently advanced to be reckoned as a working adjunct to journalistic communication.

You may imagine that because I have hitherto made no mention of other systems working at the same time in the Yellow Sea that we had the field to ourselves. This is not the case. At the same time that we were working the de Forest, within a radius of 200 miles we had countless stations installed, which were working no less than four different systems. The Italian Government has a connection which works from Pekin to Chifu, *viâ* Tsin-wan-tau. The Russian system was working between Chifu, Port Arthur, and various stations on the Kwantung Promontory. The Japanese were working from their bases along the coast of Korea, and connecting with their cruisers at sea; also occasionally the British vessels in Wei-hai-Wei would be in communication. The fact that none of these other systems or stations in the smallest degree interfered with our messages shows that the de Forest system in conjunction with its speed, possesses a merit which has not yet been arrived at by any other system. It was for this reason, as demonstrated when in competition with others at the yacht races in New York, that I selected the system as the best suited to journalistic enterprise. How far our spark interfered with other systems it is beyond my knowledge to speculate, but we were careful throughout our period never to interfere when either of the belligerents was working.

We found one enemy when the rainy season approached. That was the "static" caused by thunder storms; if the atmospheric disturbances were some distance away we could manage, but if the storm was anywhere near us it was impossible to communicate with accuracy. I may say that I have only record of one occasion on which this "static" prevented me from despatching my information. Some of you may remember that *The Times* wireless service suddenly ceased. It has been stated I believe that this stoppage of the very successful channel of information was due to a breakdown on the part of the electrical appliances, in other words, to a failure of the telephonic system we were employing. Although it is not my object in this paper to take you into my confidence with regard to any differences, which I as an *employé* of *The Times* may have had with either or both of the belligerents, yet I can safely make the statement that the reason why *The Times* system ceased was because the Japanese naval and military authorities recognised that the existence of a possible channel of leakage of military secrets presented a flaw in their plan of campaign. When such vital interests are at stake that a nation is prepared to gamble with its very existence, it would be foolish to permit a possible flaw, no matter the confidence they might possess in those who directed such an instrument as a despatch boat, equipped with wireless telegraphy. No doubt apprised of the very successful results which we had obtained, the Japanese brought *The Times* despatch boat within the limit of their control, and as that control was exercised with considerable severity, it was not deemed by the direction of *The Times* that the results obtained warranted a continuance of the enormous expense which the system entailed.

Personally speaking, although when the system was working so well I would have been prepared to have carried it on indefinitely, yet the suspension of the service brought considerable relief to my mind. At that time the Yellow Sea, and especially that portion of it which it was our custom to patrol, was alive with floating mines. Moreover, the Russians, no doubt irritated by their misfortunes, had threatened both myself and my operators with a violent death if we should chance to fall into their hands. Over and above this, there was always the fear that some energetic young torpedo lieutenant would mistake us in the darkness of night for an enemy, that viewing our length of main mast he would believe us to be a warship showing lights with the intention to deceive. Therefore, though I regretted that the system came to an end just at the moment when it seemed about to prove most useful, I cannot help thinking that as far as *The Times* representatives and the officers and crew of the *Haimun* were concerned, all ruled for the best.

To sum up, I maintain that *The Times* has amply demonstrated the value and possibilities of wireless telegraphy in conjunction with journalistic enterprise; in fact, I am inclined to think that it has demonstrated its uses too well, and that the success of the system has assisted in its downfall. Moreover, I am convinced that it will ultimately prove that *The Times* has been the first and last journal to use wireless telegraphy to report naval warfare. Although I am positive that in our hands the system was always put to proper uses, yet the possibilities and the dangers are so great that in future the use of all wireless communications during military and naval operations will be controlled by international law.

And now I think I have told you all that the limit of time allowed for this short paper will permit. But as I believe it is to be followed by a discussion, I shall be only too pleased to answer any questions which you may care to ask me, provided they are not too scientific, and I am competent to answer them.

[After the reading of the paper, Captain James showed a series of lantern slides from photographs taken by himself, and also reproductions of sketches supplied by him to the *Graphic*, illustrating the incidents of the war.]

DISCUSSION.

The Chairman, in opening the discussion, said the paper was absolutely the first authentic and realistic account that had ever been submitted of a practical demonstration of the uses of wireless telegraphy. It was, indeed, quite a unique performance, and, he was afraid, it was a final performance, because after the magnificent way in which the work had been done, no existing Government would be fool enough to allow another Captain James to go coolly and quietly, with expert assistants, and report to the London *Times* their tactics, strategy and performances. Therefore, if there was one criticism that he had to make upon the paper, it was that the work had been done too well. If it had been done badly there would have been a chance of the author going and repeating his performances elsewhere, but the author had done it too well already. He had, in fact, proved himself to be the wandering dog who found the bone; and the

audience was indebted to him for giving the bone to them. The author commenced his paper by saying that he knew nothing about wireless telegraphy. He (the Chairman) thought that he knew a great deal more about it than a good many electricians did. Captain James also intimated, that, like newspaper correspondents, he was not going to be very modest, but he thought the audience would agree with him that one of the distinguishing characteristics of the paper was the extreme modesty with which the author had refused to bring his own name to the front, while he had accorded praise, with a considerable amount of exuberance, perhaps, to his assistants. Especially was that so in the case of the chief electrical assistant on the *Haimun*, who had been so prominent, and whose letter in The *Times* was one of the finest specimens of real American fun and amusement he had ever read. There was a considerable amonnt of fear expressed by the author that the possible reduction in the height of the antenna at Wei-hai-Wei and on board ship might limit the distance to which communications could be sent, but at the present day electricians did not attribute quite so much value to the height of the antenna as they did to its electrical equipment. As a matter of fact, the antenna practically controlled the lengths of the waves that were sent, but unless one desired to communicate across hills or over obstructions, height did not matter so much as it was supposed in the early days. The chief merit of the de Forest system was the great speed with which the messages were sent, and the extreme accuracy. He doubted much whether, on any telegraphic circuit in Europe, 1,500 or 2,000 words could be sent without some error being committed either by the manipulator, by the receiver, or by the writer; but to send such messages across the sea under the circumstances which had been described meant great skill on the part of the operator and marvellous development in the instruments employed. The author mentioned the fact that the news of the battle off Port Arthur was received in London six hours before it occurred. That was just the little stretch in the vivid imagination of the poetic correspondent that allowed him to make a critical remark. It was quite true that when it was announced in London it appeared to have happened six hours before, and it was the peculiarity of latitude and longitude that caused the mistake. He would illustrate his remark with a little incident that occurred to himself in the days when the telegraph was quite as great a curiosity as wireless telegraphy was now. In 1856, when the continent was first connected with England by a submarine cable, he gave a lecture in Southampton. He determined that there should be no mistake, so he induced the secretary of the telegraph company to be present in London while he (Sir William) was in Southampton at the other end of a wire, which at a certain time he arranged should be put through to the continent; and having explained the difference of longitude, causing the difference of time, and making the same remark in the poetic spirit which Captain James had done, he said to the audience that he would call up the Hague, and requested one of the audience to ask a question. The question asked was "What is the weather in the Hague;" and the answer came back. Questions of a similar nature were put to Hanover, Berlin, Dresden and Vienna. A critical newspaper editor got up and said that he should like to test what the author had said about the difference of longitude, and for that purpose asked what the time was in Vienna. It was about 9 o'clock at Southampton at the time, the Vienna time being 9.40. The reply came back over the wire, "8.20," whereupon the editor said it was a lie, and that he (Sir William) was an impostor and was deceiving the audience, and thereupon got up and walked out of the room. He was very much concerned at the incident, and he asked the operator to inquire what had occurred; and his friend, the secretary, whom he had brought to see that everything was right, said that the cable had broken down, and as he did not want to disappoint Sir William, he had been representing all the different stations. The present audience was saved from a deception of that kind, most beautiful pictures having been shown illustrative of the author's paper.

Mr. Cuthbert Hall thought that the paper was most interesting as a record of journalistic enterprise. The author had stated in the paper that his purpose was not to narrate his journalistic experiences as a war correspondent, but to show the value of wireless telegraphy for journalistic purposes. He had listened with great attention to the paper, but had been unable to understand from it exactly to what part of the wireless telegraphy results he attached special significance. If it was the distance covered, the author had mentioned distances of 160 miles; but it was a matter of common notoriety that messages were daily sent by the Marconi system over distances of 1,500 miles. Such messages were sent to ships at sea, which were unable to get the messages in any other fashion; and, in addition, hundreds of press and public messages were sent over shorter distances, which were much greater than 160 miles. If the author referred to the number of words sent, it was also a matter of public notoriety that thousands of words were sent daily by the Marconi system through its various stations. If it was the character of the message sent, if there was a special interest in war news as apart from news of the birth of children or anything else that passed over the telegraph wires, of course he had nothing to say. It seemed to him a very striking example of the interest taken in wireless telegraphy that a literary and scientific society such as the Society of Arts entertained papers, not merely on the scientific developments of wireless telegraphy, but, so far as he had been able to gather, on the character of the news transmitted. If the real point of interest was the character of the news transmitted he had nothing

further to say, but he thought he must have missed the point, because that could hardly have been the intention of the author.

Major - General STERLING said that he quite sympathised with the action of the Japanese military authorities in stopping the author's war correspondence, because both the naval and military forces would be running a very desperate risk by allowing so expert an adversary to travel over the field of operations, and send messages all over the world. Captain James had used the de Forest system with great success. He believed that other systems of wireless telegraphy were used by the other interested parties in the locality; and he thought it would be of interest if the author could state whether the only thing which hampered his transmission of messages was natural electrical disturbance, or whether the transmission of messages from other sources also hampered him at any time during his very short but interesting career.

Mr. LUKE, after thanking the author for his most interesting paper, said it was a very great relief to him, as representative of the cable business of the world, to find that instead of the wireless system of telegraphy leading, as at one time it was thought it would do, to the ruin of the cable companies, it would not be an opponent of the cable companies but a very useful adjunct. So long as wireless telegraphy companies did not want to own the earth, to supersede submarine cables, and do away with the use of wires altogether, it seemed to him their particular sphere of usefulness would be in acting as feeders to submarine cables, which would add instead of detract from their present value.

Mr. LEON GASTER thought *The Times* was to be sincerely congratulated for the enterprising spirit it had shown in being willing to spend such an enormous amount of money in the practical development of wireless telegraphy. Not only had the experiment been successful, but *The Times* were particularly fortunate in their selection of the man for carrying out the work.

Mr. J. SHARPE asked whether the author was not of opinion that, if there was sufficient money behind the enterprise, newspaper correspondents would be willing to undergo all the risks of running the blockade in order to supply information for their newspapers.

Mr. ROLLO APPLEYARD asked the number of words per minute which were transmitted by the author with the de Forest system. Mr. Cuthbert Hall had stated that thousands of words were sent per day by the Marconi system, but he understood that the rate of transmission per minute was much greater in the de Forest than in any other system.

Captain JAMES, in reply, said that he had stated in the first paragraph of his paper that he did not profess to know anything about wireless telegraphy from a scientific standpoint; but from a working standpoint he knew sufficient, by judging results, for his employers to adopt his suggestions. In reply to General Sterling's question as to whether there was any interruption with the service, the only interruption which occurred on the *Haimun* caused by an electrical body more than one mile away, was an electrical disturbance in the atmosphere. Within one mile, a word or two had been mixed up by foreign sparks from other systems. They had worked successfully over distances varying from 70 to 150 miles with the Italian, the Russian, and the Japanese systems working all round them; it had made no difference to the messages at all: he had not the means of saying or judging whether it had made any difference to theirs. He selected the de Forest system, because he found it possessed two main essentials in which, for the purposes of *The Times*, it seemed superior to the other systems that he had watched. In the first place, it did not suffer from interference; and in the second place, the operators sent and received his messages at from 30 to 35 words a minute, against 10 and 12 words a minute of every other system with which he had come in contact. With regard to the question of blockade running, he thought that if a man had nerve enough to run blockades he would have nerve enough to take wireless telegraphy instruments with him, and international law only could deal with him when it caught him. He warmly appreciated, as an *employé* of *The Times*, the feeling which prompted Mr. Gaster to mention the expense and sacrifice which that paper went to in order to serve the public in the present as well as it had served it in the past.

The CHAIRMAN, in proposing a vote of thanks to Captain James for his extremely interesting paper, thought it was only right that he should repeat the great acknowledgments that were due to *The Times* for the spirit with which it had taken up, not only the subject under discussion, but all scientific advances that were made at any time. It was just the same in the early days of telegraphy and submarine cables; and when in 1892 he first established for the Post Office wireless telegraphy between the Scottish coast and the Island of Mull, *The Times* devoted a column to a description of how it was done. It was very remarkable in the present day that so little notice was taken of the fact that wireless telegraphy existed in 1892. In 1896 Mr. Marconi came to this country; he was very warmly received, and great practical demonstrations were made of his system, but his system was only another way of doing what was being done before. The great merit of the Marconi system, which the other systems did not possess, was that it enabled them to communicate with moving ships. It was a sea busi-

ness, not a land business at all, and it was an absolute act of absurdity to conceive for one moment that wireless telegraphy was going to compete with submarine cables.

The resolution of thanks was carried unanimously, and the meeting terminated.

SEA ISLAND COTTON IN THE WEST INDIES.

The last number of the *Agricultural News* (Barbados) contains the following article on the position of Sea Island cotton, the price of which has been but little affected by the enormous increase in the crop of of American cotton:—

"The American crop is colossal, and the decline in prices should prove to your planters the folly of suggesting the planting of any other cotton than Sea Island." Thus wrote Mr. C. M. Wolstenholme, the well-known Liverpool cotton broker to the Imperial Commissioner of Agriculture by the last mail.

The crop referred to is, of course, that of ordinary or Upland cotton. The latest estimates place the present crop in the United States at about 11,000,000 bales. This represents an increase of something like 2,000,000 bales over last year's crop. It is only natural that this very large visible supply, in addition to all the cotton of a similar grade that is being produced in other countries, should have caused a considerable drop in prices. With the price of Upland cotton as low as it is to-day (about 4d. per pound), its cultivation is scarcely likely to be profitable in these colonies.

The state of the market in Liverpool is indicated by the following quotation from the *Liverpool Cotton Association Weekly Circular* of November 25: "The cotton market has been quiet throughout the week, prices have been easier, and quotations generally show a decline." Again, the following week: "The cotton market has been more active, but prices continue to decline." The prices quoted on December 2 for American cotton were: middling, 4·77d.; good middling, 4·87d. They have since fallen to 4·1d. per lb. If these quotations be compared with quotations for the same time last year (6·84d. and 6·92d., respectively), it will be seen that the decline in prices has been considerable—nearly 3d. per lb.

Turning now to Sea Island cotton, we see at a glance that the market shows a different state of affairs. To quote again from the *Liverpool Cotton Association Weekly Circular*: "Sea Island descriptions have been neglected. The quotations for fancy Georgia and Florida are reduced ½d. per lb. Forwarded this week 269 bales Sea Island." And again a week later: "Sea Island descriptions are in limited demand at unchanged rates. Forwarded this week 235 bales." Similarly with Egyptian, it was reported that a limited business had been done and quotations had not undergone much change, varying according to quality from 7½d. to 11½d. A similar, but on the whole a more hopeful, position exists in the American Sea Island markets: Messrs. Frost and Co. report that at Charleston the market remains steady and unchanged with a continued demand, and the last report (dated November 25) from Messrs. W. W. Gordon and Co. states that the market "continued quiet and steady, with a good demand at full prices." The quotations, contained in Messrs. Frost's report for December 3, will be found in the *Agricultural News*, Vol. III., p. 405. The quotations the following week were unchanged except for a decline of ½c. for fine to fully fine.

It will thus be seen that while the market for ordinary Upland has been affected to a considerable extent by the largely increased supplies, the Sea Island market (and the Egyptian also to some extent) has remained steady. The reason for this will readily be seen if we look to the crop estimates of the Sea Island sorts. The present crop is estimated at from 82,000 to 84,000 bales, as against 75,683 bales for the last crop, and 105,955 bales for the year before. The increase in production, therefore, is very slight, and consequently there has been nothing, so far at all events, to cause an appreciable fall in prices.

What it is desired to impress upon cotton growers in the West Indies is the fact that the markets for Upland and Sea Island cotton are entirely distinct. A decline in prices of Upland does not necessarily cause a corresponding decline in Sea Island. There is, therefore, no need for cotton planters here to take alarm at the somewhat sensational notices that appear from time to time with regard to fluctuations in the cotton market. They have to remember that, while the price of Upland cotton may be affected by large supplies or speculation, they have in Sea Island cotton a product for which there is a special market and a limited supply. The production is not likely to be increased to such an extent as to cause prices to drop below a figure at which its cultivation is remunerative. Provided that reasonable care be taken in producing and marketing Sea Island cotton of the highest quality, there appears to be no reason to doubt but that prices during the next season will be such as to leave a good margin of profit. In the opinion of those who are acquainted with all the facts and circumstances of the case, the price of fine Sea Island cotton is not likely to drop at any time below 1s. per lb.

Even in the event of an appreciable decline in the price of Sea Island cotton, we are inclined to think that this would ultimately have a beneficial effect. At its present high price, Sea Island cotton is out of the reach of many manufacturers who would be likely to use it if the price fell. Once Sea Island cotton had found a wider use, it is unlikely that, when the price rose again as a natural consequence of this increased demand, it would be discarded for a return to the common grades.

It would appear, therefore, that from a general

SIR FREDERICK BRAMWELL, BART. D.C.L., F.R.S.

Born 1819. *Died* 1903

From the painting by Seymour Lucas, R.A., presented to the Society of Arts by Henry Graham Harris

review of the situation as existing to-day, the prospects of the growers of Sea Island cotton are as satisfactory as they can be, and no alarm need be felt at the movements that are taking place on the ordinary cotton market. They may have a temporary quieting effect upon the demand for Sea Island cotton, but the West Indies are aiming to supply an article which is practically unaffected by these movements.

ELECTRICITY FROM WATER-POWER.*

(*Concluded from p.* 186.)

Turning now to the British Isles, the only large-scale plant for the production of electricity by water-power at present in operation in this country is the well-known installation of the British Aluminium Company at Foyers. This installation, which was originally designed by the late Mr. Birch and carried out by Mr. W. Vaux Graham, has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilised for the production of calcium carbide, but the bulk is, and in the near future the whole of the power will be used for making aluminium. At present the gross horse-power of the plant is 7,000 horse-power, but plant for a further 2,000 horse-power is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes, which have been joined together by the raising of dams and embankments, the result being a continuous lake of about 5½ miles long by about half a mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about fifty days.

From the River Foyers the water is first passed through a tunnel 8½ ft. in diameter, cut through the solid rock, to the penstock chamber, from which the water is delivered by separate cast-iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 ft.

The British Aluminium Company have obtained parliamentary powers for a further large water-power installation on Loch Leven. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000 gross horse-power. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 ft. It is anticipated that the whole of this power will also be taken up in the manufacture of aluminium on the spot, no distant transmission being at present, at any rate, contemplated.

Another interesting water-power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Company, who have obtained parliamentary powers for this purpose. Their first installation is at present being erected under the superintendence of Messrs. Harper Bros., the company's engineers, and derives its power from Lake Llydaw, on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1-5th miles in length and about a quarter to half a mile in width. Its area is 5½ million square feet, and it derives its water from a catchment area of about 1¾ square miles, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rainfalls in Europe, amounting on the average to 180 in. per annum. In 1903 it reached the phenomenal figure of 250 in. The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw. The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged up by the snow melting on the sheltered eastern side.

By means of a dam about 100 ft. in length, the level of the lake is to be raised 20 ft. The water will be drawn from the lake by means of a tunnel 600 ft. in length at a point 30 ft. below the present level, or 50 ft. below the level when the dams are completed, with the result that there will be sufficient storage for meeting a 90 days' drought. The total fall utilised will be about 1,150 ft., and the total horse-power available, on the basis of a nine hours' working day, is calculated at 8,200. The first installation consists of two steel pipe lines and four 1,000-kw. sets, each consisting of a double tangential waterwheel coupled to a three-phase alternator giving 11,000 volts at 40 periods per second.

The company will develop the full horse-power of Lake Llydaw before proceeding further, but they have also acquired a further water-power at Llyn Eigiao, in the Conway Valley, where a fall of 800 ft. is obtainable, and where it is calculated there will be nearly twice as much horse-power available as there is at Llyn Llydaw.

One of the first objects of the North Wales Electric Power Company, as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is however, in addition, intended to supply electric energy throughout a large area, comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used, and the transmission lines will be of bare copper wires, ·324 in. in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the

* Paper read by A. A. Campbell Swinton before the British Association at Cambridge.

above-mentioned light railways. Lines are to be laid to the principal slate quarry districts of Nantlle, Llanberis, Penrhyn, and Festiniog, where a considerable demand for power exists. The distances from the power station to these places range from six to twelve miles.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water-Power Syndicate, who have by agreement obtained from Lord Breadalbane and the trustees of the Colquhoun estate of Luss important water-power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may be mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some five miles north of Tarbet, on the side of Ben Vorlich, between Loch Long and Loch Lomond. Loch Sloy, which is situated some 757 ft. above Loch Lomond, which, in turn, is some 26 ft. above the sea-level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 ft., is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 in. per annum, of which it is calculated that 60 in. will be collectable.

A dam will be constructed at the eastern end of the loch, which will raise the height of the latter by some 60 ft. This will impound some 240,000,000 cubic feet of water, capable, with a calculated net fall of 700 ft. to Loch Lomond, of maintaining some 6,000 e.h.p. on a 25 per cent. load factor for the maximum possible periods of drought, which are calculated at 100 days.

From the loch the water will be taken in the first instance along an open conduit 3,650 yards in length, which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power-house will be constructed on the shore of Loch Lomond at a spot called Inveruglas. From the end of this conduit to the power-house the water will be conveyed in steel pipes, the length of the pipe line being about 600 yards and the height of fall 700 ft.

From the power-house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electric energy to the industrial areas of the Vale of Leven and the Clyde, which comprise the towns of Dumbarton, Helensburgh, Renton, and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of whom have already intimated their desire to be supplied. The transmission line, for which private way-leaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas, and continuing across country for a distance of 22 miles to a sub-station which will be situated at Renton, about mid-way between Dumbarton and the foot of Loch Lomond, in the centre of the Vale of Leven industrial area. At this sub-station the voltage will be reduced from the 40,000 volts which it is proposed to employ for the long overhead transmission to some 6,000 to 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground.

The following are the efficiencies which it is calculated will be obtained:

	Full load efficiency. Per cent.
Open conduit .... Pipe line .... Turbines	75
Three-phase generators	94
Step-up transformers	97
High-tension transmission line	93
Step-down transformers	97
Underground distribution (say 6,000 volts average)	95
Total efficiency	58·6

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 86 per cent. in the transformation of continuous current, making a total over-all efficiencies: 55·6 per cent. for three-phase current delivered, and 50·3 per cent. for continuous current delivered.

So soon as a market has been found for the total power procurable from Loch Sloy, it is intended to utilise a further water-power—for which the rights have already been obtained—at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 ft. the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water-Power Syndicate have, in addition, obtained the rights to still further water powers on the Breadalbane estate that exist further north, and these will be utilised as soon as the demand for power justifies the capital expense. It is because of these additional powers, which will considerably extend the length of the transmission, that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000, which on a basis of 5,000 horse-power delivered, works out at about £40 per horse-power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the 20 miles of overhead transmission line only accounts for some £24,000, or about

12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent., making 13 per cent. in all, will give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out, further, that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors, each about three-tenths of an inch in diameter, the possibility of conveying as much as 5,000 horse-power over a distance as great as 22 miles with only 3½ per cent. loss by means of such comparatively small wires being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as, for instance, the 600 horse-power or thereabouts that, under the present scheme, it is expected will be required for the town of Helensburgh, the interesting point arises that the minimum size of conductor allowable is limited, not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 ft. from the ground, while at all crossings over roads they will be enclosed in a wire cage to meet the Board of Trade requirements for ensuring public safety.

The application of water-power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere; still, the above brief account of what is at present being done in Scotland and in Wales shows that there are possibilities even in this old country of which till recently but few were aware.

As regards the economies of electrical generation by water-power, no general rule can, of course, be enunciated, and every case must be dealt with on its merits, according to local circumstances. This, notwithstanding it is possible to give an indication of what is generally involved, having regard more especially to the fact that with water-power, as a rule, interest on capital plays a much greater part in determining the cost than do labour or upkeep.

Avoiding, on the one hand, small powers where the costs are likely to be abnormally high, and on the other very large powers such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep, and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

On this basis it is easy to see that to be economically sound the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000 horse-power is available for sale, and £6 can be got for each horse-power on the average per annum, the capital involved must not exceed £52 per horse-power, or £260,000 in all.

THE SLEEPING SICKNESS.

The presence of sleeping sickness on the eastern shores of Lake Victoria has given the Government of the Protectorate great anxiety. At the end of 1902 the disease had spread from its original starting point, Busoga, along the east shore of the lake as far as Port Florence. At that time it was believed that the disease was of bacterial origin, the investigation of the first Sleeping Sickness Commission having led to the conclusion that it was due to a streptococcal infection. The ordinary methods of isolation were undertaken in order to prevent the spread of disease, a segregation hospital was built at a place called German Point at Kisumu, and it was arranged that all cases occurring within a radius of ten miles of the railway station should be treated there. It was noted, however, that the disease showed no great tendency to spread in or around Kisumu, although to the north-west of the town there was a violent epidemic raging. A second commission under Colonel Bruce collected evidence tending to prove that the disease is due to an infection by a trypanosome, and that this latter is transmitted by a species of tsetse fly, *Glossina palpalis*, found in many places near the lake. The report on the East Africa Protectorate just issued [Africa No. 15 (1904)], says that this discovery showed that the ordinary methods of prevention were valueless, especially as it appears likely that the period of incubation may be prolonged to two years, or more, during the whole of which the patient may serve as a focus for the spread of the disease. At the same time, continues the report, the trypanosome theory led to one hopeful conclusion in that it could be predicted with certainty that the disease would not be likely to spread except in places where the *Glossina palpalis* was found. The exact distribution of the insect, therefore, became a matter of the utmost importance. So far as is known at present it is practically confined to a narrow area in the vicinity of the lake shore, so that if *Glossina palpalis* is the only carrier of the human trypanosome there need be little anxiety in regard to the spread of the disease into the eastern part of the Protectorate.

Unfortunately there is an area near the coast line which is infested with tsetse fly. At least three species are known to exist, all belonging to the same genus, *Glossina*, and it was suggested that the close relationship which existed between these species and the *palpalis* of the lake region might enable the former to transmit the human trypanosome just as readily as the latter does. In that case, there would be great risk of the disease spread-

ing in the coast belt, provided some infected persons were introduced into it. Experiments were accordingly conducted at Nairobi to ascertain whether any or all of the *Glossinæ* in the coast belt are able to transmit the human trypanosome. "The results," says the report, "were not entirely conclusive, but evidence was produced tending to prove that one at least of the three species of fly is able to transmit the trypanosome from animal to animal. These experiments are to be verified, as if the conclusions are correct, the prospect will be a grave one as regards fly-infected areas in the East Africa Protectorate. As, however, the tsetses of these latter are also the species which carry the fly disease of cattle, it follows that these regions are not likely ever to be thickly populated by human beings."

As bearing on the investigations which are being conducted at Entebbe by the Royal Society's Commission, and as evidence in favour of the truth of the trypanosome theory, a report compiled by Dr. Wiggins is given. Dr. Wiggins was instructed to make a thorough investigation of the whole lake coast line of the East African Protectorate, and to report on the distribution of sleeping sickness, and its relation to that of *Glossina palpalis*. Dr. Wiggins finds that where there are trees or bushes near the water, there are tsetse flies, and that where there are flies there is sleeping sickness. He finds too that there is sleeping sickness inland among those tribes who go to the lake for fish at any point where tsetses are at the lake shore. Also, conversely, that where there are no trees there are no flies, and no sleeping sickness; papyrus does not shelter them. The only river which carries the fly inland is the Kuja, which is the only one that has trees at its mouth, and thick vegetation along its course.

THE AGRICULTURAL PRODUCTS OF BOLIVIA.

Rubber is undoubtedly the principal and most valuable of Bolivian products. The belts or districts where rubber is grown and sapped are divided into four classes, according to the natural commercial outlet of the product, the first being that of the Acre or National Territory of Colonias, estimated to produce about 10,000 tons of crude rubber per annum. The second belt is that formed by the basins of the rivers Madidi, Upper and Lower Beni, Orton, Maruripi, Tahuamanu, and several lesser streams, embracing such sections of Madre de Dios, Acre, and Purus, as do not find a natural outlet through Puerto Acre. The third belt comprises the rubber forests of La Paz, and the fourth and last rubber-producing zone lies in the north-eastern district of the department of Santa Cruz de la Sierra. The department of Cochabamba also has an abundant supply of rubber trees, now commencing to be developed, and promising a great future. According to the International Bureau of American Republics, the production of rubber in Bolivia rose from 647,000 lbs. in 1890, to 2,510,000 lbs. in 1896, and to 4,180,000 lbs. in 1902. Another very important product of Bolivia is coca, which is also of considerable value. It is a shrub from two to eight feet in height, according to the locality where it is cultivated. Coca is cultivated in the lower plateaus and temperate regions of the western watershed of the Andes, in the departments of La Paz and Cochabamba. The cultivation of the plant is one of the most prosperous industries of the province of Yungas. A coca plantation with proper care may last from thirty to forty years. The total production of the coca plantations in the country is estimated at 7,700,000 lbs. annually. About three-fourths of the total production come from the province of Yungas in the department of La Paz, the balance being the product of Larecaya, Inquisivi, Caupolicán, and Yuracarez in Cochabamba. Bolivian coca commands better prices than the Peruvian product, and has, it is said, a larger demand in foreign markets, while miners and Indian labourers use it in preference to any other. Cocaine is the alkaloid extracted from the coca leaves. The physiological effects of coca vary according to the mode of using the leaves, whether in an infusion or by simple mastication. In the first case a slight nervous irritation is produced accompanied by insomnia, and in the second case its action is slow, steady and invigorating, keeping up strength without the need of food. Thus the resistance of the Indian is explained who can work steadily in the fields or undertake long and exhausting journeys without any food, maintaining his strength by simply chewing the coca leaves. It is mainly through the ports of Mollendo, Arica, and Autofagasta that the bulk of the coca exports leave for foreign markets, while it is exported to Argentina *viâ* Tupiza. Bolivian coffee is considered by many as finer than the Mocha product, and at times it has commanded a very high price in foreign markets. Yungas coffee, which was once a favourite in Europe, is now only cultivated on a small scale, but it is believed that with better means of communication and transportation facilities, coffee production will increase to the extent of making this product one of the principal exports from Bolivia. Good coffee is also produced in Beni and Santa Cruz, and exported to Chile and Argentina. The cultivation of the plant is not difficult, as it is only necessary to clear the ground of the underbrush twice a year, the first crop being gathered at the end of the third year after planting. Each tree yields from two to eight pounds every crop. In Yungas the soil is so suitable for the cultivation of the plant that coffee grows almost spontaneously. Coffee dregs or residue is an excellent fertiliser, and some use it in preference to the Peruvian guano, as it contains 85 per cent. of nitrogen. Cinchona is another important product of Bolivia, not only on account of its superior quality, but also by reason of its large production. Cinchona bark is found in all the Eastern regions of the Andes, especially in the department of La Paz, Santa Cruz, Cochabamba,

and Tarija. The number of trees in cultivation at present is estimated at six millions. Formerly there was no system of cultivation, the trees being felled in order to strip them of their bark. Now the stripping is done carefully and according to scientific methods. Bolivia was for a time the principal cinchona-producing country in the world. The Challana cinchona from the department of La Paz is the highest quality of the Bolivian bark, yielding forty-eight ounces of sulphate of quinine to the hundred pounds. There are immense cinchona forests in the department of Santa Cruz as yet unexplored. The quinine plantations of Bolivia were started by German immigrants having some knowledge of chemisty and chemical products. In size and shape and the peculiar gloss of its leaves, the cinchona tree resembles the orange. Two or three times a year three or four strips of bark are cut from the trunk and thrown upon a paved yard to dry, where, as the moisture evaporates, they curl up like the cinnamon bark. Within a year or two Nature replaces the bark that has been thus stripped off, and the tree is stripped again in other places. As the tree grows older, smaller strips are taken from the stronger branches, and the mature tree will produce an annual average of about four pounds of bark. For shipment, the bark, after it has dried for a few days, is packed in raw hide bales and exported from Arica and Mollendo. Bolivian cacao is considered on a par with the finest products of the world, as it is very rich in oil and has a delicate natural aroma. The production is sufficient for the needs of local consumption and to provide for a growing export trade. The tobacco plant is very common in the departments of La Paz, Cochabamba, Santa Cruz, Tarija and Beni, where several varieties are under cultivation, known as "Havana" "black Havana," "lechuguilla" (lettuce leaf), "lengua de buey" (ox tongue), and "criollo" (native). The total production of tobacco in Bolivia is estimated at 3,300,000 lbs. per annum. The cultivation of the sugar cane and the manufacture of its products should be one of Bolivia's principal industries. The amount of sugar cane that could be grown in the department of Santa Cruz is enormous, but the primitive methods used are a drawback to the development of this industry. It is believed that the increase in the cultivation of the cane which is also grown in the departments of Potosi and Chuquisaca, and the introduction of modern methods and improved machinery, would produce sugar capable of competing in quantity, quality and price, wlth the products of any sugar-producing country. The cultivation of the grape is one of the flourishing industries in the provinces of Mizque, department of Cochabamba; Cinti, in the department of Chuquisaca, and Loayza and Cercado, in the department of La Paz. There are two kinds of grapes cultivated in the country, the *criolla* or native variety, from the old vineyards planted by the Spaniards, and the French species, imported from Peru and Argentina. The methods employed for the cultivation of the grape are primitive, except in Cinti, where modern methods have been introduced of late. There is an immense area in Bolivia which could be devoted to the cultivation of the grape and the manufacture of its product.

ALIEN IMMIGRATION.

Reference was made in a recent issue of the *Journal* to the alien immigration figures for the eleven months ended November 30, 1904. A further White Paper has now been issued by the Board of Trade bringing the figures up to the close of the year. They show that the total number of aliens that arrived from the Continent at ports in the United Kingdom during 1904 was 195,300, as compared with 207,191 in 1903. But of these 4,949 in 1904, and 3,139 in 1903, were described in the alien lists as *en route* to places out of the United Kingdom, and the number of sailors included with the aliens who arrived at ports in the United Kingdom not *en route* to places out of it was 12,850 in 1904, against 13,432 in 1903. Deducting *en route* aliens and sailors the figures for 1904 and 1903 are 177,501 and 190,620 respectively, or 13,119 fewer in 1904 than in 1903. But a foot-note to the return says that it must "not be implied that the aliens not described in the alien list as *en route* come to this country for settlement, there being in fact a large emigration of foreigners from this country, while many of the aliens arriving from Continental ports return to the Continent."

As bearing upon the effect of alien immigration upon East-end industries, it may be interesting to quote a letter written some years ago by a director of one of the largest wholesale houses, Hitchcock, Williams and Co., of St. Paul's-churchyard, in reply to an inquiry by Mr. J. A. Dyche. The letter runs:—

"In reply to your question as to the effect upon the home labour market of the work done in London by foreign Jewish tailors, it is only fair to remind you that the foreign Jewish tailors introduced new methods of manufacture and created a trade which has become a distinct gain to the country's commerce.

"We were, we believe, the first mantle manufacturers in town to employ Jewish tailors in a factory, and it is interesting to recall our reasons for doing so. In the year 1885 the demand for ladies' tailor-made jackets came into vogue, and to meet the demand from our British and colonial trade we were compelled to import large quantities of the garments from Germany. They were made of German materials in and around Berlin.

"We tried to produce these garments in our factories but without success; our own women workers were unable to manipulate the hand-irons used by the tailors, and we could not get them to do the work. As the fashion became more pronounced,

arge orders went abroad, and in 1888 £150,000 was sent to Germany in payment for these accounts.

"In 1889 we decided to introduce foreign Jewish traders, and their special methods, into a new factory we had recently built, with satisfactory results. Their work has been excellent; British material has been used instead of German, and a large part of the money sent formerly to Berlin has been distributed among British manufacturers and in wages.

"The quality of the work has improved year by year; the garments made in our factory are better than those imported previously.

"Other English firms have followed our lead, and to-day the German press admits the loss of her trade, in those goods, with England.

"Our experience shows that these foreign Jewish tailors do a class of work which our workers cannot undertake with success, and earn a high rate of pay."

The boot trade is second in importance of the Jewish interests, but unfortunately the Jewish workman does not show to equal advantage. Here the lower class of English work has suffered considerably from foreign competition.

AUSTRALIAN FRUIT PRODUCTION.*

It is doubtful whether there exists outside the Commonwealth any adequate idea of the immense fruit-growing capabilities of the various Australian States. In Europe, America, and elswhere the name of the island-continent is generally associated with gold and pastoral produce—certainly not with fruits or flowers, though the profuse luxuriance and abundance of each constitutes one of its most characteristic features. Nearly the whole of the best fruits of the Old World have become acclimatised, and with such success that during favourable seasons they are obtained in enormous quantities, frequently of exceptional size and flavour; yet, although the soil and climate of large areas in each of the States are so admirably adapted for fruit-growing, the industry remains very imperfectly developed, partly by reason of a lack of care and skill on the part of the growers, and partly by reason of deficient means of rapid transit at reasonable rates from the more distant orchards to the principal markets. In 1902 the area under orchards and gardens in Australia was 175,483 acres, as follows:—Victoria, 58,415 acres; New South Wales, 55,847 acres; South Australia, 26,865 acres; Tasmania, 14,568 acres; Queensland, 13,023 acres; Western Australia, 6,765 acres. According to the New South Wales Government Statistician, the average annual value of the Australian fruit crop during the last five years was as follows:—Victoria, £696,000; New South Wales, £457,000; South Australia, £358,000; Queensland, £179,000; Tasmania, £177,000; Western Australia, £81,000; total, £1,948,000. The values of the oversea exports of Australian fruit in 1903 were:—Dried and bottled fruits, £22,222; fruit pulp, £37,240; and fresh fruits, £217,912; total, £277,374. According to Mr. McLean, the Victorian Statist, the fruit produce of Victoria, during the year 1903-4 comprised:—654,965 cwt. grapes, 251,373 cwt. apples, 56,495 cwt. pears, 29,113 cwt. quinces, 108,736 cwt. plums, 64,215 cwt. cherries, 88,414 cwt. peaches, 114,305 cwt. apricots, 9,635 cwt. oranges, 20,842 cwt. lemons, 8,959 cwt. figs, 22,377 cwt. raspberries, 3,122 cwt. strawberries, 14,199 cwt. gooseberries, 2,312 cwt. currants (black, white, and red), and 4,297 cwt. miscellaneous; also 113,791 lb. almonds, 13,276 lb. walnuts, 2,223 lb. filberts, and 6,677 lb. of chestnuts. This does not include fruits grown for private use. In Queensland the fruit produce of 1903 included 2,362,520 lb. of grapes, 1,112,578 dozen bananas, 340,832 dozen pineapples, and 1,150,514 dozen oranges. In New South Wales, where the statistics of fruit produce are extremely meagre, the figures include: grapes, 378,832 cwt., and oranges and lemons, 6,534,620 dozen. In South Australia the grape production in 1902-3 was 26,175,472 lb. The total grape production of the Commonwealth in 1902-3 was 57,538,200 lb., from which, exclusive of the portion retained for table use, 4,785,440 gallons of wine and considerable quantities of brandy were obtained. Grapes and citrous fruits did not thrive in Tasmania, their places being taken by strawberries, raspberries, pears and apples, which are exceedingly plentiful and of rich flavour. In Victoria and South Australia considerable attention is given to the fruit-drying industry. In the former State the output of raisins in 1903-4 was 5,986,064 lb. and of currants 838,880 lb. The dried fruits also included 25,137 lb., apples, 58,293 lb. prunes, 114,096 lb. peaches, 184,960 lb. apricots, and 17,599 lb. figs. The weights are after drying. In the Victoria orchards, as in those of the other States, considerable quantities of melons, rhubarb, and tomatoes were produced, the figures in 1903-4 being: melons, 23,109 cwt.; rhubarb, 49,259 cwt.; and tomatoes, 28,990 cwt. If the produce of private orchards were included, the totals would become largely increased. Western Australia is likely to become one of the great fruit-growing countries of the future, the soil and climate in many places being admirably adapted for the production of grapes, citrous fruits, apples, pears, plums, peaches, apricots, nectarines, &c. Suitable land for fruit cultivation is readily obtained, and there is a good local demand for all the choicer kinds at remunerative prices. The export trade is yet in its infancy, but considering that in Australia the seasons are reversed, and that all the leading British and American summer fruits, such as cherries and strawberries, are most plentiful from November to February, there should be a large oversea market for them. The most successful growers are orchardists who have had some previous experience of the industry in other countries, and are familiar with the proper conditions of cultivation. To such men the Commonwealth is a country of great possibilities.

* Communicated by Mr. John Plummer, Sydney.

TEA: CONSUMPTION AND TAXATION.

It may be some slight consolation to one here and there of the many who are complaining of an eightpenny duty on tea to be reminded that their forbears who drank tea were much more heavily taxed. It was not until the Revolution that any duty was laid upon tea other than that levied on the infusion as sold in the coffee houses, but in the first year of William and Mary a duty of 5s. per lb., and 5 per cent. on the value, was imposed. For many years very little was imported. It was not until 1677 that the East India Company took any steps for the importation of tea, and at the end of the century the imports did not exceed 20,000 lbs. a year. This importation was practically a monopoly of the company, who, if the tea was imported in their ships from the place of growth, paid less than half the duty leviable on all other importations of tea. Later on (1721) the importation of tea from Europe was prohibited, thus granting the East India Company an actual monopoly, a system which gave rise to an unsatisfactory state of affairs, and was abolished in 1833. In that year the average price of Congou was 2s. 6½d. per lb, and of Hysonan 4s. 2d. With the abolition of the monopoly the consumption grew apace. In 1840 it was 1·22 lb. per head; fifty years later it had risen to 5 lb. It is now nearly 7 lb. And not less remarkable is the shifting of the source of supply from China to the British East Indies. Thirty years ago (1875), of the tea consumed in the United Kingdom 84 per cent. came from China, and 16 per cent. from India. Ceylon did not begin to export until 1883, when it sent us 1,000,000 lbs., whilst the percentage that came from India had risen to 33 per cent. In 1896 China only supplied us with 11 per cent. of our consumption, the percentage of Indian had increased to 54 per cent., and of Ceylon to 35 per cent. In 1902 the total value of the tea imported into the United Kingdom was £8,787,000, of which only £457,000 worth came from China, the British East Indies accounting for £7,937,000.

Levied as it is the present duty on tea falls very unequally upon the rich and poor buyers, assuming the rich purchaser to buy the better teas. The present price of ordinary Indian and Ceylon tea averages about 7d. a lb. It is burdened with a duty of 8d. a lb. The lowest-priced leaf tea to be obtained on the market is 4¾d.-5d. a lb. It is crushed with a duty of 8d. a lb. Whilst the 8d. duty on the best tea represents not more than 20 per cent. upon value, the duty on the cheapest tea is over 160 per cent. The cheapest leaf tea sold to the public by the retailer is 1s. 1½d. per lb. How can it be sold at that price? Take the lowest-priced leaf at 4¾d.-5d. a lb., add a 1½d. a pound for handling, and the duty of 8d., and there is 1s. 2½d. The conclusion is irresistible, that the tea sold at this price is mixed largely with dust, and made up with re-dried leaf.

Mr. Herbert Compton has given an interesting analysis of the financial aspect of the tea question as it affects the East Indies and the Mother Country. With the average market value of Indian and Ceylon teas at 6½d. per lb., the value of the total Indian and Ceylon tea crop of (approximately) 240,000,000 lb. duty paid, is £14,500,000, landed in this country. This sum he dissects and apportions as follows:—To the British Government for duty, £8,000,000. To Indian Government railways, British steamship companies, and London wharfingers for carriage from Indian tea-gardens and delivery into bonded warehouses, £1,500,000. To British manufactures of tea lead, garden stores, agricultural implements, and tea actory machinery, &c., estimated at about ¾d. per pound of tea turned out, £750,000. To the tea planters for growing and manufacturing the crop (including profit if any) on over £30,000,000 British capital invested £4,250,000. The return to the tea planter upon his capital has fallen to about 3 per cent.

Reference was made above to the increase in the consumption of tea. The returns indicate the extent to which the duty affects the increase. In 1885, with the duty at 4d., there was an increase of 4·25 per cent. In 1886 the duty was raised to 6d., followed by a decrease of 1·92 per cent. The average increase for the three years following was 1 per cent. For the ten years 1890-99 the duty was only 4d., and the average increase in consumption was 2½ per cent. In 1900 there was a 6d. duty again, and the increase for the year was ·74 per cent., probably the figures for the past year, with the eightpenny duty, will show a decrease. If not the only explanation is that the public have consumed a much larger quantity than heretofore of a very inferior tea mixture.

COAL EXPORTS.

During the fiscal year 1903-4 the exports of coal, &c., were just upon 47,000,000 tons, and the bunker coal only a little short of 17,000,000 tons. This is the largest output upon record, and it is reasonable to assume from it that the coal tax has not materially affected the volume of our coal exports. The continuous upward movement of these exports is very remarkable. If the last fifty years are taken, it will be found that four out of every five show an increase on the preceding year, and every quinquennial average of the half century shows an increase on its predecessor. With the exception of 1877 the decline was never over 5 per cent., and in that year it was very little more—14,881,000 tons as against 15,690,000 tons in 1876. Often in the face of circumstances that must have exercised a very prejudicial effect—as for example last year, which was a very bad one from the shipping point of view—the growth has gone on. Financial panics, famine prices, commercial depression, all have had to be reckoned with, but they have been hardly traceable in the total figures. Labour disputes seem to have been more accountable for the heavier decreases, than anything else. In 1877, when

the decrease amounted to a little over 5 per cent., there were numerous labour troubles, which, coupled with the falling off in the Baltic demand, explains the shrinkage of the year. The effect of labour troubles are clearly traceable in the particular groups of shipping ports more immediately concerned, but the enormous expansion in the use of steam, more especially for navigation purposes, has usually more than made up in the grand total of exports for the deficiency of particular districts.

With an export last year of close upon 64,000,000 tons, the opinion expressed by the Coal Commission of 1866 reads strangely. In this report, issued in 1871, the Commissioners stated that "as regards the future exportation of coal, although a very large increase has taken place within the period embraced by the preceding table (1855-1869), yet there is reason to doubt whether much further increase will take place in this direction." The export given in the table for 1869 was 10,245,000 tons, and if we add 2,100,000 for bunkers, the total is 12,345,000, as against the 64,000,000 of last year! And yet the majority of the Commissioners were men of acknowledged ability and great scientific attainments.

The reduction in freights consequent upon the substitution of steam for sail has had much to do with the growth of our coal exports. Mr. D. A. Thomas, M.P., gives some very striking figures under this head. He shows that outward coal freights, in what may be called ordinary times, are now not half what they were thirty years ago. 1901 represented a normal condition of things, and if the freights ruling in that year are compared with those of 1872, it will be found that the average coal freight from Cardiff to eighteen principal ports in the French and Mediterranean group was 14s. 1d. in 1872 and 6s. 4d. in 1901, a fall of over 55 per cent., while the general average of the freights to forty ports in different parts of the world fell from 20s. 2d. in 1872 to 9s. 10d. in 1901. Broadly, normal coal freights are less than half what they were a generation ago. In 1902 the average freight (5s. 4d.) from Cardiff to Port Said (3,072 miles) was below the cost of carrying coal by rail from Sonth Wales (say the centre of the Rhondda Valley) to London (170 miles), Liverpool (175 miles), or Southampton (128 miles).

MOLASCUIT.

Mr. George Hughes (Consulting Chemist to the Agricultural Society of Barbados) lately gave an address at Lewes on "The Cultivation of the Sugar Cane, and the Processes of Manufacturing Sugar, with especial reference to the utilisation of its Bye-products," before the East Sussex Farmers Club.

The crushed cane leaving the mills is called megass, and this hitherto has always been used as the fuel to boil the juice into sugar and molasses. This procedure is something akin to burning straw if it were necessary to use much fuel to produce marketable corn. Doubtless it is an excellent use for the rind, but the interior of the megass from which the juice has been expressed Mr. Hughes found on analysis to be 75 per cent. digestible, and, therefore, suitable for feeding purposes. It has now been demonstrated that it is quite easy to separate what might be described as this honeycomb by disintegration and screening.

Showiug a sample of screened megass meal, he said, the absorbing properties of this are remarkable, but this fact is not surprising, seeing that the cells of which it is formed originally held 90 per cent of juice.

The crop of molasses obtained for each ton of sugar is equal to from 5 to 7 cwt., according to the condition of the juice, which is much affected by the seasons. In many places this bye-product is taken to distilleries and converted, after fermentation, into rum. Of late years the price of this commodity has been much depressed, and, if not an actual loss to manufacturers, it has barely covered the expense of production. Molasses would long ago have been more largely used for cattle feeding but for the expensive packages necessary for shipment, and the difficulty of handling them has been a deterrent of its coming into general use for this purpose. You cannot make a meal of molasses pure and simple, but by taking 20 per cent. of the dry megass meal, 80 per cent. of molasses is easily absorbed and so completely that the product is not even sticky if the megass meal be fairly dry. It can then be dessicated and the 25 to 30 per cent. of water in molasses more or less replaced by this dry, digestible megass matter.

Everyone knows that sugar pure and simple cannot be taken in any quantity at a time, because, all being soluble at once, it would soon nauseate and upset the digestion, but Mr. Hughes said he could show that molascuit slowly gives up its saccharine matter, in a simple experiment by mixing water and decanting, and water poured upon the sediment still yields sweetening matter. It is therefore practically a natural food made entirely from the one product, the sugar cane almost in its natural state, only the cells charged with this concentrated molasses instead of original juice.

It is not reasonable to look upon this new commodity as a complete food, but it will be found a valuable addition to all other feeds in proportion to the nitrogen matter they contain. It may in time reduce the necessity of growing mangolds. The practical farmer will chaff his hay and straw and mix molascuit with this chop, and not forgetting to add the water which would have been found in his roots to the extent of 90 per cent. One ton of molascuit can equal eight tons to ten tons of mangolds, the feeding of which, according to analysis, is chiefly dependent upon sugar. I make this statement, not as a proved fact, but a point upon which experiments can be made, and certainly one that invites discussion.

The British farmer often pays a fancy price for compound feeds, and many of the feeds have established their reputation, on the fact, although not

generally known, that they contain molasses or sugar in their composition. Here you have molasses in a dry condition, admirably suited for mixing with your other feeds, be it hay, straw, or cotton and linseed cakes, &c., and molascuit should be sold at a price which means economy to the farmer.

Mr. Hughes further quoted figures showing the increase in the use of molascuit. In 1903 only 1,762 tons were exported; last year, up to November 17th, 5,445 tons had been sent over from British Guiana alone.

CHINESE TOBACCO.

The cultivation and manufacture of tobacco is one of the great industries of Ssuch'nan. The plant is grown extensively throughout the province for local consumption, but the chief centre of production and export is the Plain of Ch'êngtu, notably the districts of Chin-t'ang Hsien, P'i Hsien and Shih-fang Hsien. Many years ago, the excellence of the Ssuch'nan leaf was discovered, and trial shipments were made to Europe, and if better methods of production were introduced into the growing districts, it is expected that the industry would have a great future, especially in foreign markets. The seed is sown in a seed bed in October, and the bed is then watered with liquid manure, and covered with rice straw; when the seedlings have attained the height of half an inch, the straw is removed, and screens made of rape stalks are set up to protect them from frost, snow and cold, to which they are exceedingly sensitive. If the weather is dry during the winter months, the seedlings are watered several times. Consul-General Hosie says that in March they are sufficiently advanced to be transplanted into rows, eighteen inches apart, and a like distance between the plants. A considerable interval is left between each set of two rows, and at the end of April the plants are banked up, each two rows forming a bed of fine black loam about two and a-half feet wide, with the plants near the edges, while the intervals between the beds are converted into trenches two feet deep by two and a-half feet wide at the top, and narrowing to about one foot at the bottom. These trenches are the irrigation channels, and the Plain of Ch'êngtu being one network of streams and canals diverted from the Min River, it is a very simple matter to allow the water access to any particular field as required. After banking up has taken place, the trenches are filled with water every morning to within an inch or two of the surface of the beds, and as the plants are close to the edges, their roots are easily irrigated. Every four or five days, however, liquid manure is applied to the plants instead of water. By the middle of May the plants have grown to the height of a foot or more, and the tops are then snipped off by hand to prevent flowering and to divert the sap to the leaves which have already attained large dimensions. Irrigation now practically ceases unless the weather is exceptionally dry and the crop is harvested from the middle to the end of June. Each leaf with its stalk, is carefully removed by hand and spread between two openwork bamboo screens capable of holding twelve or thirteen leaves without overlapping. The screens are placed in the sun for four or five days, when they are opened and the leaves, which are now of a brown colour, are removed. The contents of about a hundred of these screens are then placed together between two larger but similar screens, and firmly bound with rope for four or five days, when the bundle is opened and each leaf removed separately by hand and assorted into bundles of about three and a half catties (about five pounds avoirdupois) in weight, each of which is tightly bound with a band of rice straw encircling the flat bundle across the width. Each bundle contains about one hundred and thirty leaves. In this form, called "Ta yen," or large tobacco, the bundles are packed, circulated throughout the provinces, and find their way down the Yangtsze beyond the borders of Ssuch'uan. The smaller leaves, called "Er yen," or second tobacco, having undergone the same processes as the preceding, are manufactured into "Shui yen," or water tobacco, for smoking in the Chinese water pipes. The stalks and larger veins having been removed by hand from the leaves, the latter are spread in layers in a wooden box, and rape oil is sprinkled between each layer. When full, a lid is placed on the top and weighted with stones to press out the superfluous oil. After two days stones and lid are removed, and the contents of the box are cut up into slices about two inches wide. These slices are placed in a press for from four to six days, till they are sufficiently hard to be planed into thin tobacco called "Tiao Ssu." An inferior quality of water tobacco is made by adding with the rape oil a certain quantity of "T'u-hung," a red-coloured earth, to the leaf when placed in the box. This quality is called "Shuang Lan." The stalks and veins of the leaves are dried, ground up, and added to the water tobacco. The tobacco most generally manufactured and consumed in Ssuch'uan, as well as exported, is called "So yen," or cord tobacco. The leaves are harvested, and each leaf is cut close to the stem of the plant. Two inches of the end of each stalk are bent over to form a hook, and by this means the leaves are hung on cord or rope stretched under cover in sheds or under the eaves of houses. In the centres of tobacco cultivation special sheds are erected for the purpose. The leaves are in this way exposed to the air for twenty days. At the end of that period they have changed from green to brown and have shrivelled up laterally. On the twenty-first day they are hung outside the shed for one night and exposed to the dew. Next morning they are taken in and rolled up tightly with the cord in bundles of about 26 pounds in weight. After two days the bundles are opened, suspended under cover for two days, and again exposed for one night in the open. This takes place a third time, when the leaves are removed from the

cord and assorted according to size. They are now ready for market. The district of P'i Hsien is credited with only 2,000 piculs (about 120 tons) of cord tobacco, its principal energy being devoted to the production of "Ta Yen," "Erh Yen," and water tobacco, which is placed at 120,000 piculs (about 7,200 tons). Chin-t'ang and Shih-fang districts, on the other hand, devote themselves for the most part to the manufacture of "So Yen." The consensus of native opinion is that the best flavoured leaf in the province of Ssuch'uan is grown in the district of Chin-t'ang, and is closely followed by P'i Hsien and Shih-fang Hsien. The best "T'u-hung" or earth red, used for mixing with the inferior water tobacco, comes from Chiang-an Hsien on the Yangtsye, between Lu-Chou and Hsü-chou Fu.

NAVAL EXPENDITURE AND MERCANTILE MARINE.

The Parliamentary paper on naval expenditure and mercantile marine just issued is useful although its title does not accord with its contents. It claims to be a return showing aggregate naval expenditure on sea-going force "for the year 1903," but the figures for the United Kingdom are only brought down to the 31st March, 1903, whereas those for Germany and Japan are down to the 31st March, 1904, and for the United States to the 30th June, 1904. Again, in comparing aggregate naval expenditure and aggregate revenue the aggregate revenue of Russia is put at £218,676,000, which must include items not shown in our Budget of £141,545,579. With a merchant shipping of 10,268,604 tons to protect the aggregate naval expenditure of the United Kingdom on her sea-going force was £35,525,732. Russia with an aggregate tonnage of mercantile marine of only 678,594 spent £12,349,567 upon her navy, and France with a merchant marine of 1,217.614 tons spent upon her fleet £12,538,861. If we spent as much in proportion to our merchant fleet as, say, Russia, it would cost us over £150,000,000 a year. But of course fleets are maintained for purposes besides the protection of merchant shipping. For example, that of Russia in the China seas, and of France in the same waters. Perhaps the most remarkable figures in the returns are those which relate to Japan. The aggregate naval expenditure on sea-going force of Japan for the year ended 31st March, 1904—a year of preparation for war and war itself—was only £2,354,904. Hardly less remarkable in a different way are the figures relating to our self-governing colonies. They have an aggregate revenue of £69,491,029, and between them they contributed £361,959 towards the up-keep of the Imperial Navy. The Dominion, whose aggregate revenue (£13,574,286) was more than half that of Japan (£25,518,000), and exceeded that of Portugal (£11,877,000) by nearly two millions, and was practically the same as that of the Netherlands (£13,833,000) paid nothing. Nor are the discrepancies between the Colonies themselves less striking. The Dominion of Canada has 683,147 tons of merchant shipping and contributes nothing towards the navy that protects it; Natal has only 2,241 tons of shipping yet contributes £25,625. The Commonwealth contributes £259,869 for the protection afforded by the Imperial Navy to its 357,509 tons of shipping; the Cape of Good Hope which has only 3,681 tons contributes £62,500.

LONDON BUILDING AND THE COUNTY COUNCIL.

The London Building Acts Amendment Bill which the London County Council will invite Parliament to consider and adopt in the coming session, is a formidable measure of 184 clauses, not to speak of the schedules. Its object, as its title implies, is to amend the Acts relating to buildings in London, and to confer various powers on the Council. According to the Preamble, the existing powers possessed by the Council "are insufficient to secure the construction and maintenance of streets and buildings in the Administrative County of London in a satisfactory manner, the provision and maintenance of proper means of escape in case of fire from such buildings, and the reduction of the risk of fire in the case of such buildings." Some of the most important provisions of the Bill are those that relate to "means of escape in case of fire, and provisions for reducing risk of fire in buildings." If Parliament adopts these provisions in anything like their present shape the risk of serious conflagration in London ought to be materially lessened. Clause 54 stiffens Section 47 (height of buildings) of the Act of 1894, and provides that consent to the erection of certain high buildings shall not be given "unless both the superintending architect and the chief officer of the Fire Brigade certify that proper arrangements can be made and maintained in connection with such building or lessening the danger from fire." No person without the consent of the Council may erect or raise "any dwelling-house to a height greater than the width of any public street or way adjoining the same, and used for the purposes of foot traffic only, whether formed or laid out before or after the commencement of this Act, unless such dwelling-house shall be so erected or raised that no external wall thereof shall be in any direction at a less distance than twenty feet from the centre of the roadway." No stairs may be constructed with a rise of more than seven inches and a half, or a tread of less than eight and a half inches, clear of nosings, except in the case of windows.

Clause 81 provides that "In every church or chapel, meeting-house, public hall, public lecture room, public exhibition room, and public place of assembly, whether constructed before or after the commencement of this Act, all exit doors and barriers shall be made to open outwards, and if fastened during the

time the building is in use, be fastened during such time by automatic bolts only so as to open outwards by pressure from inside." That is a most valuable provision, although it will surprise many to learn that the County Council have still to ask the sanction of Parliament for powers to enforce the making of doors to open outwards. Clause 87 again has much to commend it. It runs, "All constructed iron work in any new building shall, with the object of protecting the same from the effects of fire, be encased to the satisfaction of the district surveyor, the concrete, brick work, terra-cotta, or match lathing and plaster, or cement not less than two inches in thickness." Again, no materials may be used in the construction or alteration of any building if they have been disapproved by the district surveyor on the ground that they are of bad quality.

Part VIII. deals with the means of escape in case of fire, and seeks to reduce risk of fire in buildings. All "high buildings," that is, buildings with the level of the upper surface of the floor of any storey a greater height than fifty feet above the level of the footway, must have the certificate of the Council that its requirements have been complied with before it may be occupied or let for occupation. Clause 105, which deals with access to roofs, is very important. It provides that every building, having more than one storey above the ground storey, or exceeding 25 feet in height, shall be provided with either a dormer-window or a door ~~opening on to~~ the roof, with proper access to it; or a trap-door covered with copper or zinc, and hung on hinges so as to admit of the same opening to the fullest extent, and furnished with a counter-weight so as to ensure that it shall open automatically when unfastened, and also with a fixed or hinged step-ladder leading to the roof; or other proper means of access to the roof, and with a sufficient parapet or guard-rail where necessary, to prevent persons slipping off the roof. Any dormer-window or trap-door provided under the sub-section shall only be fastened in such a manner as to ensure access to the roof being always readily available from the inside of the building. It will be the duty of the district surveyor, on finding that there has been failure to conform to these requirements, to forthwith serve on the owner notice to carry out all such works as may be necessary to conform to the Act.

Space does not allow reference to any other clauses dealing with the fire danger, or to refer to other matters such as lines of building frontage, prohibitions of irregular structure or forecourts, communication bodies, the height of buildings, the numbering or naming of streets, light and ventilation of habitable basements, &c. Enough has been said to shew that this is a very wide-reading Bill. No doubt it will be largely amended in details in its course through Parliament, but its main provisions are not likely to be materially altered. Unfortunately the coming session, with its dissolution possibilities, may be too short and stormy to enable the necessary time to be given to the consideration of this very important measure.

BOHEMIAN INDUSTRIAL EXHIBITION OF 1906.

For some considerable time past, especially in German manufacturing circles, plans have been maturing for the holding of an industrial Exhibition of more than ordinary magnitude in Reichenberg in 1906, and, according to the United States representative at that place, complete success has been achieved. The guarantee fund amounts to nearly £120,000, to which every City in German Bohemia has contributed. This fund is only a guarantee against financial loss, and therefore does not represent the outlay on buildings, grounds, and administration, for in that part of Europe these exhibitions are conducted upon a purely business basis, and are expected at least to meet expenses. A large number of workmen have been engaged in preparing the grounds, and it is proposed to complete the buildings, so that everything, including installation, shall be ready on the opening day in May, 1906. The Exhibition is to remain open until October. As no other Exhibition, either in Austria or Germany, is thus far in contemplation for 1906, it is practically certain that Reichenberg will then monopolise the attention of the exhibitors and public in German Europe. All branches of Bohemian industry—manufacturing, forestry, arts, &c—will be represented in collective exhibits. As manufacturing in Bohemia, though carried on to a vast extent, is scattered in small villages over a wide territory, it will afford a good opportunity for the inspection of Bohemian products, especially in cotton, linen, wool, glass, precious and imitation stones, imitation jewellery, and the peculiar manufactures of the Gablonz district. To an inquiry as to whether foreign exhibits were desired, or would be permitted, answer was made that auxiliary machines and materials, such as are not manufactured in Bohemia, would be admissible; in other words, only non-competitive articles. Applications for space, which should be accompanied by full particulars of the proposed exhibit, are to be addressed, An die Austellungsleitung gräfl. Schloss, Reichenberg, Böhmen.

CORRESPONDENCE.

RURAL HOUSING AND BUILDING BYE-LAWS.

It may be of interest to supplement the information contained in the note on "Building Bye-laws," in the last issue of the *Journal*. In the twenty years, 1881 to 1901, there were created 244 urban districts. That many of these are not in reality towns is shown by the Registrar-General, who observes, in his report, "A considerable number of urban districts, though technically urban, are distinctly rural in character, being in many cases small towns in the midst of agricultural

areas, on which they are dependent for their maintenance as business centres. At the recent census (1901) there were as many as 215 urban districts with populations below 3,000; 211 with populations between 3,000 and 5,000; and 260 with populations between 5,000 and 10,000. In other words, nearly two-thirds (686 out of a total of 1,112) of the urban districts have less than 10,000 inhabitants." The density of populations may be gathered from the fact that in the 260 districts with populations between 5,000 and 10,000, there were on an average less than 1,500 persons to a square mile, as compared with 18,000 per square mile in towns of over 250,000 persons, and about 39,000 in the County of London.

There is unanimity of opinion that the existing state of rural housing is attributable to some extent to rural authorities having applied, with the consent of the Local Government Board, urban regulations to rural areas. But sufficient publicity has not been given to the fact that had rural authorities followed more closely the intentions of the Public Health Act, 1875, the present state of affairs might not have arisen.

For however weak the Act of 1875 may be in some respects, it clearly distinguishes between the public health requirements of town and country. A marked distinction is drawn, for example, between the duties delegated to officials in urban and rural areas. Whilst it is compulsory upon urban authorities to appoint a medical officer of health, surveyor, and inspector of nuisances (Sect. 189), the officers which every rural authority *shall* appoint are the medical officer or officers of health, and the inspector or inspectors of nuisances (Sect. 190).

It is particularly noticeable that no provision is made, in the sections quoted, for the appointment of surveyors in rural areas, and that this omission was intentional is shown by the term "surveyor" as applied to rural areas being merely included among the definitions to the Act (Sect. 4), thus:—"'Surveyor' includes any person appointed by a rural authority to perform any of the duties of a surveyor under this Act."

Hence the Act of 1875 implied that in rural districts surveyors' duties should be of so light a nature as not to necessitate the appointment of a special officer. The fact, too, that the section referring to the appointment of rural officers is worded to include the plural as well as the singular in the cases both of medical officers and inspectors of nuisances, is a further indication that the Act of 1875 anticipated the sanitary work in those districts would be covered by the duties devolving upon the two grades of officers mentioned, and provision was accordingly made for increasing their number if necessary.

These intentions of the Legislature have been frusfrated by the adoption of urban building bye-laws, for the majority of rural councils have thus created the work of urban surveyors over the whole of their districts, and have in some instances considerably extended the work by adopting other Acts of an urban character. This has had the effect in many districts of bringing existing (or old), as well as new buildings, under town restrictions.

When it is remembered that in addition to the powers thereby placed in the hands of surveyors, the medical officers of health and sanitary inspectors have also far-reaching powers over drainage, water-supply, unhealthy dwellings, and other sanitary work in close relation to the duties of surveyors, it is not surprising that in rural districts the over-lapping of work has become vexatious to the public.

In a review of the rural housing question which appeared in a former issue of the *Journal*,* it was shown that some urban powers tend to prejudicially affect sanitary administration in rural areas, and in the interest of sanitation, if for no other reason, rural councils should confine the adoption of urban powers to such parts of their districts as have actually become urban in character. There is perhaps no more mistaken notion in the mind of the general public than that urban powers are bound to lead to sanitary improvements in rural parts. As a matter of fact, urban powers are often as unsuitable for country areas as rural regulations would be if applied to crowded cities.

T. BRICE PHILLIPS.

GENERAL NOTES.

STERILIZING WATER.—An apparatus for sterilizing water, designed by Mr. P. G. Griffith, is described in *The Times*. The apparatus is based on the fact, which he claims to have proved by his experiments, that in order to kill the organisms of water-borne diseases, such as enteric, cholera, and dysentery, it is unnecessary to have recourse to a temperature so high as boiling point, but that they are immediately destroyed by heating the water to any temperature above 73° C. (164° Fahr.). He takes advantage of this circumstance to economise heat by not using temperatures above 80° C. (176° Fahr.) for the operation of sterilizing, and he effects a further economy by employing an interchange cooling arrangement by which the heat of the water which has passed through the boiler is transferred to that which is on its way to be sterilized. In this way the ingoing water is made to enter the boiler at a considerable temperature, the consumption of fuel being thus reduced, while a corresponding cooling is effected in the sterilized water, which therefore becomes available for drinking purposes much sooner than would be the case if it issued almost at boiling point. An important feature is a device which automatically cuts off the supply of water to the cooler whenever the temperature of the water in the boiler falls to 73° C. (164° Fahr.). This consists of a series of metal capsules, containing liquids which boil at different

* "The Rural Housing Question." *Journal of the Society of Arts*, vol. lii., March 25, 1904.

points, and so arranged that the water-valve remains closed by a spring until it is forced open by their expansion. A similar arrangement, acting in the reverse sense, extinguishes the lamp should the temperature of the boiler rise unduly owing to failure of the water supply. Heat is obtained from a petroleum vapour lamp. The experimental apparatus on view at 396, Euston-road, is capable of yielding about 60 gallons of water an hour, with a consumption of something over 30 oz. of oil, or about half an ounce of oil to a gallon of water, and the delivery of sterilized water begins four or five minutes after the lamp is lighted. The weight is about 120 lb., but it could probably be reduced. The machine was primarily designed for use with armies in the field, and the water, strained through cloth or charcoal to remove coarser suspended matter, may either be supplied from a water cart through a flexible pipe or pumped up from any convenient stream or pond.

INDIAN IMMIGRANTS IN TRINIDAD.—The Annual Colonial Report for Trinidad and Tobago for 1903-4 states:—That during the period under review, four immigrant ships arrived from British India, bringing with them 2,458 persons, of whom 676 were women. One return ship to Calcutta conveyed 721 persons, and money to the value of £9.320 besides gold ornaments. These figures, while bearing testimony to the comparative wealth which the thrifty East Indian imported under indenture can attain in this colony, indicate also that Trinidad is annually losing, by return to their native land, an appreciable number of men and women who have proved themselves to be desirable citizens.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

JANUARY 25.—"London Electric Railways." By the HON. ROBERT P. PORTER.

FEBRUARY 1.—"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S. SIR ROBERT HANBURY BROWN, K.C.M.G., will preside.

FEBRUARY 8.—"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY. GEORGE DAVISON will preside.

FEBRUARY 15—

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN, F.S.A. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

Dates to be hereafter announced:—

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Lake Baikal and its Connection with the Great Siberian Railway." By ARTHUR GULSTON.

"Application of Electricity to the Location of Mineral Deposits." By ALFRED WILLIAMS.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

APRIL 6.—

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

JANUARY 24.—"British Commercial Prospects in the Far East." By BYRON BRENAN, C.M.G., late H.B.M. Consul-General at Shanghai. SIR EDWARD A. SASSOON, Bart., M.P., will preside.

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILY HEWITT. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials." By MARION H. SPIELMANN, F.S.A. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S I., will preside.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR LALIQUE (Paris). ARTHUR LASENBY LIBERTY, J.P., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic, and Fountain Pens." Three Lectures.

LECTURE I.—JANUARY 23.—*Ancient Writing Implements.*—The Stylus and Tabula—Calamus or reed pen—Stencil—Quills, quill nibs, attempts to make quills more serviceable—Substitutes for quills—Silver pens—Ink horn and penner—Ancient writing outfit—Eastern writing implements—Survival of ink horn—Japanese writing box and pens—Their portable writing set—Early metal pens—Steel pens—Barrel pens—First patent for metallic pens—Improvements in steel pens with the object of increasing their ink-holding capacity — Reservoir nibs, various illustrations.

LECTURE II.—JANUARY 30.—*Stylographic Pens.*—Rudimentary forms—Early patents—Rigid points, needle points—Various writing or marking pens—Modern Stylographic pens, Nota Bene, Cygnet, and others—Gold pens, description of manufacture.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements — Self-filling reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

DUGALD CLERK, "Internal Combustion Engines." Four Lectures.

February 13, 20, 27, March 6.

HERBERT LAWS WEBB, "Telephony." Four Lectures.

March 13, 20, 27, April 3.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. James P. Maginnis, "Reservoir, Stylographic, and Fountain Pens." (Lecture I.)

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Mr. James Ransome, "European Architecture in India."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Alfred East, "A Landscape Painter in Japan."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Hugh Stannus, "Architecture from Egypt to Rome."

TUESDAY, JAN. 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. Byron Brenan, "British Commercial Prospects in the Far East."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Mialls, "The Structure and Life of Animals." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. James Forest Brunton, "Notes on the Working of the Shone System of Sewerage at Karachi." 2. Messrs. Edmund Herbert Stevenson and Edward Kynaston Burstal, "The Sewerage of Douglas, Isle of Man."

Anthropological, 3, Hanover-square, W., 8½ p.m. Annual Meeting.

WEDNESDAY, JAN. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Hon. Robert P. Porter, "London Electric Railways."

Royal Society of Literature, 20, Hanover square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JAN. 26...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Hilaire Belloc, "The Growth of a City—London."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Churton Collins, "The Philosophy and Significance of 'The Tempest'."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Messrs. W. H. Booth and J. B. C. Kershaw's papers, "Fuel Economy in Steam Power Plants."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Dr. Vaughan Cornish, "Wave Phenomena."

FRIDAY, JAN. 27...Royal Institution, Albemarle-street, W., 8 p.m., Weekly Meeting. 9 p.m., Mr. A. E. Wilson, "The Life of the Emperor Penguin."

Civil Engineers, 25, Great George-street, S.W., 8 p m. (Students' Meeting.) Mr. T. L. Matthews, "Concrete-making on the Admiralty Harbour Works, Dover."

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Messrs. J. B. Fulton and E. F. Reynolds, "Byzantine Architecture."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m. 1. Dr. R. S. Willows, "Action of a Magnetic Field on the Discharge through a Gas." 2. Dr. R. S. Willows and Mr. J. Peck, "Action of Radium on the Electric Spark." 3. Mr. P. Phillips, "The Slow Stretch in India-rubber, Glass, and Metal Wires when subjected to a Constant Pull." 4. Mr. C. A. Bell, "Determination of Young's Modulus for Glass." 5. Dr. Boris Weinberg, "Some Methods for Studying the Viscosity of Solids."

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

SATURDAY, JAN. 28...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Charles Oman, "Wat Tyler in London." (Lecture II.)

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FRIDAY, JANUARY 27, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 30, 8 p.m. (Cantor Lecture.) JAMES P. MAGINNIS, "Reservoir, Stylographic, and Fountain Pens." Lecture II.

TUESDAY, JANUARY 31, 8 p.m. (Applied Art Section.) EDWARD JOHNSTON and GRAILY HEWITT. Two papers on "Calligraphy and Illumination."

WEDNESDAY, FEBRUARY 1, 8 p.m. (Ordinary Meeting.) SIR WILLIAM H. PREECE, K.C.B., F.R.S., "The Navigation of the Nile."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The Society's Examinations will commence Monday, April 10th.

As previously announced, important changes have been made in the Examinations this year. These changes, however, affect the classification of the candidates only, not the general system of organisation.

There are now three Divisions or Stages:—
1. Elementary. 2. Intermediate. 3. Advanced.

The Examination papers for the three Stages will be separate and distinct. Candidates failing in the Advanced or Intermediate will in no case be granted a lower Stage certificate.

Candidates who have not previously passed in the Society's Examinations are strongly recommended to enter in the first instance for the Intermediate Stage.

Candidates who have already passed the

	Monday, April 10. (7—10 p.m.)	Tuesday, April 11. (7—10 p.m.)	Wednesday, April 12. (7—10 p.m.)	Thursday, April 13. (7—10 p.m.)	Friday, April 14. (7.15—10 p.m.)
Advanced Stage.	Accounting and Banking. Portuguese. Précis-writing. Russian. Chinese. Japanese. Hindustani.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Book-keeping. English. Economics. Danish.	Shorthand (7.15 to 10 p.m.)
Intermediate Stage.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Typewriting (7.30 to 10 p.m.). French. Danish. Commercial History and Geography.	Shorthand (7.15 to 10 p.m.)
Elementary Stage.	German. Typewriting (7.30 to 10 p.m.).	Handwriting and Correspondence. French. Italian.	Book-keeping Spanish.	Commercial Geography. Arithmetic.	Shorthand (7.15 to 10 p.m.)
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

Second-class or Third-class of the old Grade II. and have made progress, ought to be able to take the Advanced Stage.

The papers set will be of the same character as those of previous years, which will therefore, as hitherto, form a useful guide to the nature and scope of the Examinations.

The following new subjects have been added:—

Elementary Stage—Italian.

Intermediate Stage—Hindustani.

Advanced Stage—Commercial Law. Accounting and Banking, Hindustani.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted to each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates are given; in Harmony, Higher, Intermediate and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the Programme.

In choosing the subjects in which they desire to be examined, candidates must take notice of the arrangements of the Time-table, as they cannot be examined in more than *one* subject on each evening. The days and hours of Examination must be *strictly* adhered to.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

The Time-table of the Examinations for this year is given on the preceding page.

The Programme for the present year can be had, price 3d., on application to the Secretary, Society of Arts, Adelphi, London, W.C.

CANTOR LECTURES.

On Monday evening, 23rd inst., Mr. JAMES P. MAGINNIS delivered the first lectures of his course on "Reservoir, Stylographic, and Fountain Pens."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday, January 24, 1905; Sir EDWARD A. SASSOON, M.P., in the chair.

The paper read was "British Commercia Prospects in the Far East," by BYRON BRENAN, C.M.G., late H.B.M. Consul-General at Shanghai.

The paper and report of the discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 25, 1905; The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, David, Ashdale, Satanita-road, Westcliff-on-Sea.

Childs, Harry, 47, London-street, Reading.

Dawbarn, Alfred H., 1, St. James's-place, S.W.

De-la-Motte, Freeman Alexander, Cadnant-park, Conway.

Gabbett, Edward, Public Works Department, Maymyo, Burma.

Hobhouse, Mrs., The Ridge, Corsham, Wilts.

Hyde, John, Lanier Heights, Washington, D.C., U.S.A.

Kodandaramiah, Khajana; Sompet, Ganjam District, Madras, India.

Macaulay, Thomas F., Rosbrien-house, Limerick, Ireland.

Mahler, Miss E., Sudworth, New Brighton, Cheshire.

Morris, Steven William Savin, P.O. Box 691, Cape Town, South Africa.

Munro, Laurence, Kronsbein-building, 10, Main-street East, Hamilton, Ontario, Canada.

Pottie, George, 42, Mansfield-road, Ilford, Essex.

Powell, A. H., Neston, King's-avenue, Ealing, W.

Rees, John David, C.I.E., 17, Pall-mall, S.W.
Sadler, Henry Knight, 5, St. Andrew's-place, Regent's-park, N.W.
Slessor, Major Herbert, R.M.A., Eastney Barracks, Portsmouth.
Smith, Harold Bayldon, A.R.I.B.A., 11, Constitution-hill, Port Elizabeth, Cape Colony, South Africa.
Straker, Donald, Haslemere, Surrey.
Waugh, Percival Bentley, Whitehall Club, Parliament-street, S.W.
Whitehead, Sydney, 24, Queen's-road, Wimbledon, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bayley-Worthington, A. B., 8, Balfour-place, Mount-street, W.
Deadman, Thomas W., 58, Northcote-road, St. Margaret's, Twickenham.
Forbes, David, 5, Benedict-road, Brixton, S.W.
Hatschek, Emil, A.M.I.Mech.E., 24, West Twenty-fifth-street, New York City, U.S.A.
Haynes, Josiah Edward, Union Offices Stroud and Paganhill, Stroud, Gloucestershire.
Kerr, Rennie Malcolm, Gokak Falls, Belgaum District, India.
McLaren, William David, A.M.I.Mech.E., Thomason Engineering College Workshops, Roorkee, India.
Mitchell, Arthur Edward, 10, Lower Mount Pleasant-avenue, Rathmines, Dublin.
Nicholls, Captain Alfred Edward, Cotswold, Hornchurch, Essex.
Reynolds, Major James M., Burdett, New York, U.S.A.
Weiskopf, Alois, 3, Sophienstrasse, Hanover, Germany.
Wharton, William Hewley, L.R.C.P., 1, Brick dam, Georgetown, Demerara, British Guiana.
Wilson, George Lewis, 522, High-road, Tottenham, N.

The paper read was—

LONDON ELECTRIC RAILWAYS.

BY THE HON. ROBERT P. PORTER.

Cities, like individuals, differ so widely and so fundamentally, that what suits one is not adaptable to another; that, in short, the system of locomotion possible and successful in one city, may not be practical, or may prove a failure in another. One might compare existing conditions in London with those of New York, Paris, Berlin, Chicago, Glasgow, Vienna, Buda-Pest, Philadelphia, Hamburg, Liverpool and Boston, with a very small percentage of practical results. For nearly two years a Royal Commission has been sitting at intervals and gathering information on London traffic. In the course of its inquiries some of its members have visited these cities; but it would be interesting to know how much of practical value they brought away with them that can be applied to the conditions that confront us in dealing with rapid transit in London. I do not contend that it is unimportant for those dealing with London traffic to be acquainted with what other cities are doing in this direction, or to ascertain by what agencies difficulties are being met. Such information is of value if only to show what not to do; but I am of the opinion that after all this information has been obtained, we come back to the original problem of London and how to relieve its congested streets—a problem which can only be successfully worked out by methods in harmony with existing conditions, and not by grafting methods which have been developed under entirely different conditions elsewhere.

To further illustrate this, it is only necessary to glance at some of the maps of the larger cities of the world, and to note their physical variations. One authority thinks he discerns that nearly all large cities are laid out and developed on one of three distinctive plans (each plan requiring a different general system of transport routes to serve its population), namely, the peninsula, the valley, and the radiating plan. I think these divisions may be increased by introducing the "semi-radiating." The peninsula plan has a water front on both sides, such as New York, San Francisco, and Stockholm. The valley plan has a river running through the centre, and the most populated and business districts on both sides of the river, such as Pittsburg and Rome; the semi-radiating plan, with territory on one side of the water front, such as Chicago, Liverpool, St. Louis, Boston, Brooklyn, Milwaukee, and other cities of lesser importance. It is hardly fair to classify such cities in the radiating plan, because unlike London, Paris, Berlin, Glasgow, Manchester, their radiation is entirely on one side. Aside from geographical considerations, there are geological conditions, which though overcome to a considerable extent by modern engineering, have made it difficult, if not impossible, to accomplish engineering construction in one city that has been comparatively easy in another. Especially has this been the case in underground work, in which the clay soil of parts of London has made both tunnelling and tube railways practicable, while, until

quite recently the solid rock on which New York is built, was an obstacle for tube work, and extremely difficult for shallow subways. I remember, when the first subway in Boston was projected, the grave doubts that were entertained by the engineers as to the successful issue of excavating the sandy soil upon which that city is built, and the fears lest the work should undermine the foundations of buildings. Again, few people who knew Chicago immediately after the fire, and watched the enormous amount of pile driving (reminding one of Amsterdam) which preceded the construction of the large public buildings and blocks of that city, would believe that at a level of 40 feet below the surface, an enterprising company has practically duplicated the street of the entire business district. When recently in Chicago, I was given the plans of Bion J. Arnold, a well-known engineer, who has been employed to furnish a scheme for the further relief of traffic in the congested districts of Chicago, in which he proposes (in addition to these freight tunnels already constructed) as the best plan a combination of north and south high level subways, with three or more low level subways with lifts similar to those in London, as the most practical method.

But aside from physical difficulties in the treatment of rapid transit of modern cities, there are political, and in continental Europe, military exigencies, which enter largely into the problem. The agitation for underground railways in Paris began in the fifties, about the time when the first metropolitan underground section from Paddington to Farringdon-street was constructed and opened. The principal reason of the opposition of the municipality of Paris to underground railways was one that might be regarded as the strongest reason for adopting them in London, namely, that they took people outside the city boundaries into the suburbs. This was a curious attitude—to oppose new railways because they would prove of public convenience; but it will be readily understood when it is explained that such facilities would involve a serious interference with the octroi tax (the chief source of municipal revenue) by effecting a large transference of homes beyond the octroi. So for a generation or more underground railway schemes slumbered in Paris, and a variegated assortment of trams and omnibuses and motors, with every sort of propulsion known to the human race, have struggled with a varying degree of success with the street passenger traffic.

Turning to Berlin, it would be impossible, in glancing at the map of that city, not to observe that military considerations, as in Paris, had a much larger share in the design of the Ringbahn, or "Circle" Railway, opened in 1877, than any desire to facilitate the passenger traffic.

Rapid Transit Incubates Slowly.

As it is my purpose briefly to discuss underground electric railways in the solution of the traffic problem of London, it is not necessary to do more than refer to the underground systems in other cities, because London may be regarded as the home of them all, both tunnels and tubes. Nor is it necessary to remind this audience that the elementary scheme for the construction of a metropolitan underground railway was projected more than sixty years ago, and after seventeen years of agitation, the first Bill for the construction of the Metropolitan Railway (the section between Paddington and Farringdon) was passed in 1854. The work was not begun until six years later (in 1860), but once started, it was pushed on rapidly, and the line opened for traffic in 1863. Here we have the nucleus of the underground systems, which were increased from time to time very much on the instalment plan, and nearly a generation had passed away before the final link of the Inner Circle, comprising the Metropolitan and Metropolitan District Railway, was completed. However impatient we may sometimes be with the present generation, it would be as well for our nerves perhaps if we occasionally revived the memories of the long protracted controversies of our fathers. However fast we may travel when all the work now in progress of completion is open for traffic, and all the recommendations of the Royal Commission on London Traffic now under consideration are carried out, and all tracks of the surface railways entering and crossing London are electrified, history tells us that rapid transit incubates slowly, and requires much careful nursing in order to bring it to a healthy and vigorous maturity. Paris, as I shall presently show, has been nearly a half a century developing its Metropolitan Underground Railway. New York, with all its new world energy, appointed commissions and talked for nearly a quarter of a century before it got down into the rock and built its subway; and even the breezy city of Chicago allowed that well-known street railway expert (Mr. Yerkes) to come and go before it seems to have discovered that below the

juicy mud into which it had driven piles to hold up sky-scrapers, was a clay as good, if not better, than that of London, through which to cut its tunnels. No! Whatever may be said of the condition of the underground railways of London when the electrification was undertaken by the joint enterprise of England and America, the Inner Circle was for its time a monumental work of engineering. In this, as in so many other branches of constructive engineering enterprise, England showed the way for other countries to follow. To be sure this assertion has been qualified a little by my friend, Mr. James Dredge, the Editor of *Engineering*, who recently said, "It is our way, when we have completed some great work, to be so satisfied with the completion and execution that we leave it to remain unaltered, a great monument, forgetful of the fact that such monuments mark the graves of progress." But in the case of the Metropolitan and the District, this does not apply, for the present year we hope will find them altered.

The First Tubular Railway.

From the first underground railways, we naturally turn to the first tubular railway which was made possible by the application of electricity for traction purposes, and we find it to be purely a British idea, and first put to practical use in London. An interesting account of the origin of tubular railways appeared a year or two ago in the testimony of Sir Benjamin Baker before a Parliamentary Committee:—

"Mr. Charles Gras Mott, Chairman of the South London Railway (said Sir Benjamin Baker), came one day and told me that he proposed to go to Parliament for a tube railway from Stockwell to the City, going under the Thames by London Bridge. Undoubtedly the present state of the tube mania, as you may call it, dates from that time. I told Mr. Mott that there would be a tremendous parliamentary opposition, because it was a novel affair; questions would be raised of damage to property, damage to London Bridge and all the other things. And so it turned out; but, however, after great hesitation, the Act was granted. The late Mr. John Walter, M.P., of *The Times*, was the Chairman of the Committee, and I remember he told me the day after that he was so anxious about it, and about the danger of making these tube railways, especially as regards London Bridge, that he went at 5 o'clock in the morning and stood on London Bridge and pictured to himself London Bridge tottering, and then he thought after a while, that if this thing be a great success it would lead to a great development, and he finally hardened his heart, and he passed the City and South London. That is the origin of all these tube railways. English engineers are reproached for want of enterprise, but they cannot be reproached in this respect. This is solely a British idea."

Through the courtesy of Mr. Thomas, of the *Graphic*, and Mr. Jenkin, General Manager of the City and South London, I am able to present slides showing the ceremonies at the opening of the first London tube, November 4th, 1890, upon which occasion Mr. Mott, the present chairman, took the chair, and the King (then Prince of Wales) made a speech, in which, among other things, he said:—

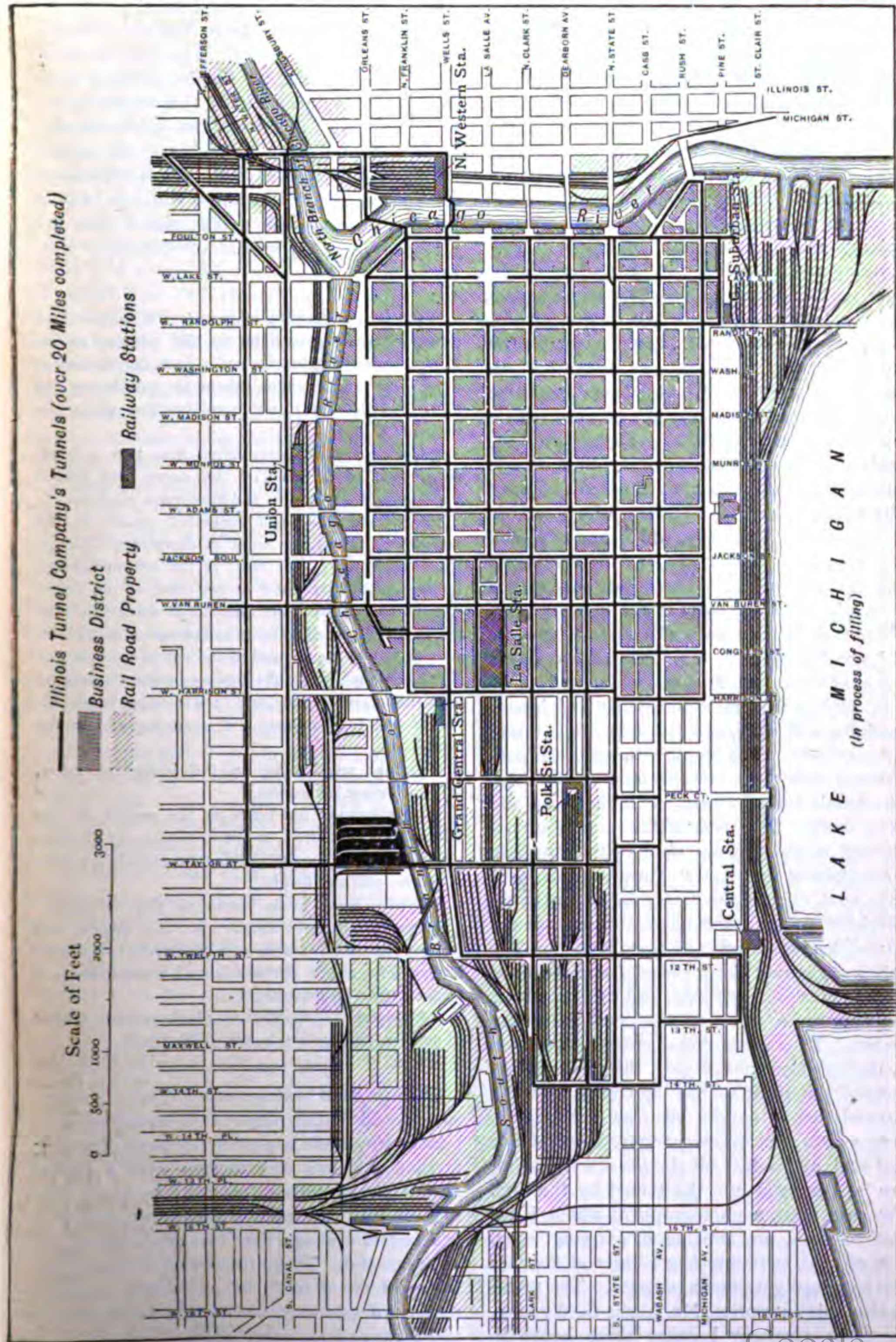
"I have also to return you my thanks for having given me the opportunity to be here to-day, and to have inaugurated a work which I have little doubt will be of the greatest use to the community at large, and especially a great boon to this great metropolis. It must be a matter of sincere thought to all of us, the ever-increasing growth of this great metropolis, with its means of access, owing to the great increase in the population, becoming more and more difficult. Therefore this railway to-day, this first electric railway which has been started in England, will, I hope, to a very great extent do much to alleviate the congestion of the traffic which now exists, so that business men who have a great distance to go will find easy means of getting away from this great city and enjoying the fresh air of the country; and that it will also be a great boon to the working men who are obliged to work in an unpleasant atmosphere, who will be able to get away for a little fresh air. Not only is this railway a very remarkable one from a scientific point of view, but it has this great advantage, that it has two tunnels. This is distinct from the one tunnel which characterises the present underground railway; and also the advantage that it has netiher smoke nor steam, and ample ventilation."

There were many difficulties experienced in the promotion, construction, and equipment of the first electric tube, and it was not until Mr. C. G. Mott, a director of the Great Western Railway, became chairman, that the money was raised, and the work fairly began. Electric traction was then in its infancy, and various plans were discussed and abandoned before a satisfactory system was at length worked out. It was at first proposed to place the motors at each end of the train, but subsequently, fearing the Board of Trade might object to this arrangement, it was determined to put both motors on a separate vehicle of light weight, which could be easily attached and detached from the trains. This was the form finally adopted, and the railway has been worked on this principle ever since it was opened, and the arrangement being recognised as efficient and economical,

its use has spread far and wide both in this country and abroad. No objection being now raised by the Board of Trade, the motors on most of the other railways are being placed on the carriages of the train, but the City and South London still adhere to the separate locomotives, the general manager believing they have an element of safety, and are as efficient in working. The railway has now been extended to Clapham Common on the south, and to the "Angel," at Islington, on the north; and a further extension to King's-cross, St. Pancras, and Euston, is in progress of construction.

THE NEW TUNNELS OF CHICAGO.

Having given full credit to the British metropolis for inaugurating underground and electrical tubular railways and to British engineers for first putting them in operation, you will pardon me if I digress in order to call attention to some interesting work I have recently inspected in other cities, notably New York, Chicago and Boston, and to what is going on in the construction of underground railways in Paris and Berlin. Not that I think these undertakings have much bearing on the present solution of the traffic problem of London, but they are, in themselves, instructive and enterprising experiments well worth a reference on this occasion. First, we will take Chicago, because that go-ahead city has evolved and really put into operation something original in the way of electrical underground transportation. The idea seems to be "the streets for the people, the tunnels for merchandise, coal and freight." We heard something of this kind last year before the Royal Commission on London traffic from Sir Henry E. Knight, who, you may remember, proposed to construct a tube under London large enough to enable whole truckloads, by means of lifts or inclines, to be sent on the tube lines without any transhipment at the goods stations. At the time, this proposal seemed to strike the London daily press as humorous, but in Chicago it is being strongly urged as sensible and practical. If such a scheme as this were put into force it might relieve the streets of the crawling vans, and of that hideous innovation, the motor lorry. Another reason why this motto appealed to Chicago was that the promotors ingeniously announced their intention at the psychological moment, after a protracted strike of drivers and truckmen, during which the strikers refused to permit the dead, conveyed by non-union men, to be driven to the cemetery. But I am getting a little ahead of my story and must describe the new Chicago tunnels and the condition of affairs which has produced them. The growth of population in Chicago has, as you know, been very great and very rapid. At the time the first section of the London Underground was opened, the population of Chicago was about 150,000. To-day it is more than two millions. So you will see that they have had to move a little more rapidly in their undertakings to meet this increase of population than has been necessary in some of the older cities. From 1837, when Chicago first appears as having any population at all, to 1902, the average rate of increase in the population has been a little over $8\frac{1}{4}$ per cent. per annum. London during this last half century has increased in population about $1\frac{1}{4}$ per cent. per annum. The increase of railway mileage centreing in Chicago has been as great, and in 1902 that mileage so centreing and having its termini in the city amounting to not less than 40 per cent. of the entire railway mileage of the United States. As you will see from the map, these railways all pour in their freight and passengers in sections of the city fronting along the river, which has an unfortunate fault, so the Chicago people think, of running both north and south, and east and west, and hence it must be crossed in many directions. The city, therefore, is divided into three divisions. This water barrier has been the fixed condition that has been recognised and referred to. Town divisions were established on its lines and its boundary divides all wards throughout its course. The water, gas and sewage systems are laid out with regard to it. Diagonal streets or avenues to the business centre are determined by its course. In short, it is primarily responsible for the congested condition of the business centre, honeycombed with freight depôts, limiting as it does by its moveable bridges its area to a little more than a square mile, that is, the section within the area besieged as it were by these railways, about a mile wide and a mile and a half long. It goes without saying that the manufacturing district has grown up along the course of this river, and naturally all lines of business that can be more profitably conducted by navigation have sought its frontage, while the Lake Shore is being appropriated for parks and pleasure gardens. The banks of the three branches of the river have been built up by all sorts of industries, and the whole area forms a concen-



Emery Walker sc.

Underground Railways of Chicago.

tration of freight and traffic business that would be difficult to find in almost any other city of the world. The value to a district of this sort of a duplicate of all its thirty miles of streets, forty feet below the surface, is naturally great. Here, then, is what I found, to my surprise, when in Chicago last month. The story of the construction of these tunnels is perhaps the most interesting and picturesque branch of underground railway building that we are likely to touch upon this evening. While Chicago may have been a long while in discovering the value of underground railways, after that discovery was made, the promoters of the enterprise lost no time in carrying it out. Work on the tunnels was commenced on the 3rd September, 1901, and in 12½ months from the date of actual work, 12 miles of tunnel were completed, making an average of more than a mile of tunnel per month. Last September, three years after the inauguration of the work, over 30 miles of these tunnels were finished and equipped with rails and overhead electric wires, and the Illinois Tunnel Company, which has exploited this enterprise, expects to have it completed and ready to deliver not less than 50,000 tons of freight each day early in the present year. These tunnels have walls of concrete, and are of horseshoe shape. They are of two sizes; trunk conduits, 12 ft. 9 in. wide, and 14 ft. 6 in. high, inside measurements; and lateral conduits, 6 ft. wide, and 7 ft. 6 in. high, inside measurement. The smaller tunnels are constructed with 13 in. bottoms and 10 in. walls. The trunk tunnels have 21 in. bottoms and 18 in. walls. The roofs of the tunnels are not allowed to come closer than 24 ft. 6 in. from the surface of the street. These tunnels, as I have said, contain the cables for an automatic telephone system now in operation, and already serving between 4,000 and 5,000 stations. The cables are strung along the roof and the walls of the tunnel on each side, and room is left on the floor for a track or tracks of a railway system. By an additional ordinance, passed by the City Council last year, the company has secured the right to use apparatus for the transmission of freight, such as newspapers, mail matter, packages, parcels, merchandise and coal, and in fact all classes of freight that can be conveyed into the tunnel by the lifts. The cars used, a photograph of which I am able to show, are capable of carrying seven tons of coal, or twenty-four barrels of flour, or two large upright pianos in cases. The president of this enterprise, Mr. Albert G. Wheeler, in whose company I spent three hours in these tunnels, informed me that he had already made a number of contracts for the supply of coal to the large business blocks, hotels, manufactories, &c., in this district. You will no doubt be wondering how these tuunels are to be operated, and the answer to this question I will leave to the gentlemen who have promoted and carried out the undertaking. We have here their advertisement, in the crisp, terse inimitable Chicago way of putting it before the public, taken from the *Chicago Daily Journal* of October, 31st, 1904:—

"*What the Subway means to Chicago.*—Clean streets, pure air, sunlight for the people, underground subway for freight traffic, just the reverse of New York and London, where the people are put underground, and teaming and trucking given the preference.

"Coal, ashes, dirt, excavations from new building sites, offal, &c., taken off the streets and hauled underground, all the dirt and annoyance abolished.

"Relief for the most congested district in the world, in 1½ square miles of downtown Chicago there is centred 35 per cent. of the railway mileage of the United States and 14 per cent. of the entire world's mileage, the terminals of 38 truck line railroads. In this small territory an average of 40,300,000 tons of freight are shipped in and out in one year.

"Every building in the business district equipped with tunnel connections, and thus in direct communication with every railroad and steamship line in the world.

"Freight, merchandise and fuel hauled in, ashes, dirt and refuse hauled out.

"Uninterrupted free traffic on the surface for the people who walk, drive, or ride in surface and elevated cars—the streets for the people, the tunnels for merchandise, coal and freight.

"While New York boasts of the 'Subway,' Chicago quietly goes ahead with the largest and longest system of tunnels ever constructed—12 miles longer than any in the world—and many miles still under way to be constructed.

"A system unparalleled in all the world—typical of modern, progressive, hustling Chicago."

Chicago itself having spoken, it is only necessary to add that a company representing on its board many of the important railways centreing in that city, has been formed with a capital of £10,000,000 to take over the property from the original construction company, and it is believed in Chicago that the experiments will be successful. Those interested in these problems of street traffic of cities will naturally watch its development with considerable interest and perhaps some speculation.

Rapid Transit Work in New York.

Passing from Chicago to New York, it is not my intention to describe the various systems of rapid transit of that city any more than it has been my aim to do in the case of Chicago, but merely to add a few words describing the operation of the new subway which was opened a few months ago, and to refer to some of the additional undertakings now in progress of completion which have for their purpose the improvement of the existing facilities in this city. As a matter of fact, it may be said of New York that from the Battery to 150th Street it is a perfect gridiron of mechanical traction. To be sure, there are many cross-town horse-cars still remaining in wards called the down town district, but there are ten or a dozen longitudinal surface tramways with their cross-town connections, which carry in the neighbourhood of 600 million passengers annually, and none of these railways appear on the map of New York, to which I shall call your attention. The map shows only the elevated railways, the subways present and proposed, the New York Central Railway tracks, and the important improvements already inaugurated by the Pennsylvania Railway Company. Two sections of the subway have now been completed and opened. These sections comprise the first of the subway schemes. The construction work was begun on March 24th, 1900, and completed in a little over four years, the second section being opened while I was in New York. The contract covered the construction of a four-track subway from City Hall to 96th Street, a distance of 6·71 miles, an extension to the west side of the City of Kingsbridge, made up of 3·85 miles of three-track construction, and three miles more of two-track construction; and an extension on the east side of the city to Bronx-park of 2·89 miles of three-track and 4·24 miles of two-track construction, making a total of 20·69 miles of subway and elevated structure, providing for 63 miles of single track.

It is sometimes assumed that these 20 miles are all subway, but such is not the case. There are 10½ miles of subway, built with steel columns supporting the streets ("cut and cover" lines laid within a few feet of the street surface), 4½ miles of concrete arch construction (*i.e.*, tunnel work through hills or elevation or under streets where underground tracks had to be avoided), and 5 miles of elevated structure (*i.e.*, the viaduct at the extreme north ends of the two branching lines). The local service consists of five-car trains, which run on a one minute headway on the main part of the line, with alternative trains to each branch. The contract calls for a speed of 14 miles an hour from end to end of the line, but this if anything is, I think, exceeded. The average distance between the stations is 2,300 feet. The photographs, which have been kindly given me specially to be used at this lecture by Mr. Barclay Parsons, the chief engineer of this important work, will give you some idea of the New York subway trains in operation. The cars are very comfortable, and it is surprising how quickly the motor men and other officials have taken up this new business, for unlike the electrification of the existing railways here, and for that matter, the electrification of the Manhattan, the New York subway was started up as it were in the night, whereas in cases of electrification of steam railways, the electric trains run for a time interspersed with steam locomotives, and the change is gradual. The whole thing works as smoothly as if it had been going on for a number of years. I find the express trains running at average speeds of thirty miles an hour, specially convenient in reaching points like 72nd and 95th Streets. You can save time if you are going to an intermediate station, some distance from the business section of the city, by taking an express train to the nearest station, and a local train which stops at every station.

Work under Construction in New York.

On the map, which we are looking at, is shown not only the new subway as in operation, but the proposed lines which in all probability will soon be under construction, for I note in a cable despatch from New York that the last report of the engineer of the Rapid Transit Commission, who has this matter in charge, will probably be put into effect. This will give another line from the down town district to connect with the present subway at 42nd Street. It will also give another line along Lexington-avenue towards the East River. There will also be some linking up in what is called the Borough of the Bronx, and an extension beyond the present termini in that division, in the direction of White Plains. I also call attention on this map to what are called the Hudson River Tunnels, connecting New York or Jersey City and New York with Hoboken; the first of these tunnels goes under the river from Hoboken to Christopher-street, and the second from Ex-

changer-place, Jersey City, to Church and Cortland-streets, in New York.

This brings us to the important work which the Pennsylvania Railway Company is doing in New York, some idea of which may be gathered by the admirable photographs which were presented to me specially for this paper by Mr. George Gibbs, a member of the committee of the engineers appointed to superintend the work. By this enterprise, a solution of the problem of the physical connection of New York City with the trunk lines terminating on the west bank of the Hudson in Jersey City, will be solved, as well as a through connection without ferry transfer with Long Island. The single length of its tunnel line from its portal in New Jersey to its portal in Long Island will be 5·6 miles, and in this distance there are to be somewhat over 15 miles of single track tunnels. Long Island, as many present are aware, is not only an excellent summer residential stretch of country bounded on the west side by the Atlantic Ocean, on the other by Long Island Sound, but Montawk Point is about 200 miles nearer Queenstown than New York, and it has long been the cherished idea of certain enterprising railway men in America to make this the port of departure for some of the large ocean liners. These important tunnels of the Pennsylvania Railway Company, completed so as to make a direct rail route from any part of the United States under both the rivers and New York, make the journey by water considerably less. The Pennsylvania Railway Company has acquired the entire Long Island Railway system which runs along both shores with a third track through the centre of the island. The amount of lighterage saved by these important constructions, to say nothing of the additional convenience to passengers, will be enormous. It is said that the cost of these Pennsylvania improvements will be in the neighbourhood of £10,000,000 sterling. A comprehensive engineering and construction agreement for the mechanical and electrical engineering for the entire work has been made with Messrs. Westinghouse, Church, Kerr, and Co., who I think were also selected as engineers to the architects. The general direction of the whole work is assumed by President Cassatt, and the special supervision by Mr. Samuel Rea, fourth Vice-President, to whom all departmental bodies report. I wish it were possible for me to explain with some detail the extent and character of this undertaking, which in its tunnels and underground project is one of the greatest ever undertaken. To do so and to use even a part of the material given me when in New York, would be sufficient for an evening lecture. The photographs and plans will give some idea of its magnitude and importance. While an American firm has charge of the electrical side of the work, an English firm (Messrs. Pearson and Son) has the equally difficult task of driving these tunnels under the two rivers. The tubes will be driven by the shield method through the silt composing the river bottom, and with the aid of compressed air. Near the east shore of the North river it is expected that rock will be encountered. The general design of these tube tunnels is shown in the figure I produce on the screen. They are of heavy flanged cast iron sections, lined with concrete two feet in thickness. The substantial supports for the railway, consisting of steel screw-pile columns, are also shown, these supports being used in all silt formation. A novel provision, insuring safety in operation, will consist of the concrete side benches extending above the level of the car floor, and which will provide convenient walks as well as housing for the cable ways, &c. This combination of British and American engineering will undoubtedly bring about very satisfactory results.

The terminal station, some excellent photographs of which are presented, has, as you will see, a yard located below the street level, and the site occupies the four city blocks bounded by 9th Avenue, 7th Avenue, 33rd and 31st Streets, and includes the closing and occupation of 32nd Street on the surface from 7th to 9th Avenue; also a large section of the property between 9th and 10th Avenues on 32nd Street. The entire tract, measuring about 1,200,000 square feet, will be occupied by the terminal station yard at a level of about 45 feet below the surface. The excavation will involve the removal of some 2,000,000 cubic yards of material and the construction of massive retaining walls surrounding the excavation will require the use of some 50,000 cubic yards of concrete in the walls. The station tracts will be 21 in number, and the yard will include an area of about 20 acres under four blocks.

Not to be behindhand, the Pennsylvania's competitor, the New York Central, has undertaken a vast scheme of electrification. The necessity for this change arose from the serious inconvenience to the travelling public due to the use of steam locomotives in the four-track Park Avenue Tunnel, which extends from 56th

Street to 96th Street, a distance of about two miles. Furthermore, the City of New York desired the lowering of the tracks of the Grand Central Yard and terminal from 56th Street South to 42nd Street, so as to permit the restoration of the cross streets from 45th Street to 56th Street inclusive, which heretofore have been cut in two by the approaches to the terminal. This depression of the yard and terminal, with the consequent roofing in of the tracks by streets and viaducts, was not feasible with steam locomotive operation, and hence arose an additional necessity for using electricity as a motive power. The New York Central has also a large suburban traffic, as will be readily seen by the location of their lines on the map. The work of electrification is proceeding rapidly, and the new equipment includes electric locomotives, power house, turbo generators, surface condensors, and other auxiliary power station apparatus. The actual placing of these orders marks a profoundly important epoch in the application of electricity to the hauling of trains on the main line of one of the leading railways of the world. For the first time electric motors will compete in performances with steam in hauling heavy express trains of 500 tons and over at speeds exceeding 60 miles an hour. The change, I was told in New York, is expected to show marked economies in the electrified part of the railroad as a whole, and it will mean a great increase in the suburban traffic to Croton and White Plains, due to the purification of the tunnel, and the running of multiple unit trains every few minutes.

Speaking of this change from steam to electricity, it is necessary to mention the work completed about a year ago of electrifying the Manhattan Elevated Railway of New York's entire system of 40 miles. A comparison between the cost per car mile as worked by steam and electricity shows an economy of over 1d. per car mile, that is, it has been reduced from a trifle less than 6d. to 4¾d. per car mile. The working expenses decreased by 3½ per cent. last year as compared with 1903, whilst there was an increase of over 40 millions of passengers, and the net earning for the year advanced over £500,000.

The subject of New York transportation, like that of London, could easily form the topic of an entire paper of this kind, and so at the best I can merely mention these matters as we go along. To sum up, it may be said that the existing services are extending wherever possible, and the few remaining horse routes are being electrified where practicable. The Manhattan or "Elevated" proposes some additional linking up and extensions. Work on the subway already opened from the City Hall is in progress under Broadway to bring it down to the extreme end of New York, where there will be an additional extension under the river to Brooklyn. The Brooklyn extension is about 3·1 miles, having eight miles of single track, and the estimated cost is from £1,600,000 to £2,000,000. These works actually in hand, including two new bridges across the East River to Brooklyn, and other projected subway proposals, together with a new Manhattan subway belt line of 16 miles, sufficiently indicate rapid transit activities in New York.

NEW HARBOUR TUNNEL AT BOSTON.

While I have shown that New York has in course of construction several schemes for tunnels under both its rivers for taking passengers out of the city to Long Island or Brooklyn on the one side and New Jersey and Hoboken on the other, Boston has just opened to travel the first tunnel constructed by an American city to take the lines of its street car system under the water of an open harbour. It connects the mainland of the old Shawmut Peninsula, on which the business part of the Hub is built, with East Boston, still known familiarly by its Colonial name, Noddle Island, and is a mile and four-tenths long. The tubes contain two tracks equipped for the overhead trolley service employed on the surface lines of the Boston Elevated Railway, for at its suburban end the tunnel cars run on the regular street tracks. It is 24 feet from floor to roof, and its walls and arch are constructed entirely of concrete. It is the first tunnel in which that material alone is thus used. The cost has been about 3,000,000 dols., and it has taken about four and a-half years to complete the work. In Boston the opening of the tunnel to travel is regarded as important, mainly because it is a step in the progress of the New England metropolis toward the most comprehensive system of rapid transit that any American city has. It marks the completion of another of the great arteries of traffic which have been planned to take care of the expected growth of population, and is part of the comprehensive general scheme of the Boston Elevated Railway Company, which operates all the local street car lines, except a suburban line or two from the north. The tunnel runs from Maverick-square, East Boston, to

Scollay-square, in the city proper. The length of the harbour section is 2,700 feet and the depth of earth between the top of the tunnel and the harbour bed is about 20 feet. The minimum of earth over the bore after the harbour has been dredged to 40 feet depth will be about five feet. For further accommodation of traffic in the heart of the city there is now building a tunnel under Washington-street, the main artery of Boston business, that will be given over wholly to the use of elevated trains, which, when it is ready, will be withdrawn from the present Tremont-street subway, the pioneer construction of its kind in the United States, leaving that once more for the sole use of surface lines, for which it was originally built. The Rapid Transit line to Cambridge will also be underground in Boston and elevated on the other side of the Charles River; this tunnel will not be constructed until the completion of the new West Boston bridge, which, however, is well along towards completion.

THE NEW METROPOLITAN OF PARIS.

Returning to Paris and Berlin, it is necessary to say a few words about the Underground Electric Railway of the French metropolis. I have mentioned the original opposition of the municipality to underground railways on the ground that they would take the people out of Paris. After years of fruitless endeavour on the part of the travelling public, the French Government finally yielded, and consented to the line being built by the municipality as an independent railway not connected with the Paris terminal stations of the great railways. It is safe to assume that this attitude of the Paris municipality, together with the necessity of strongly fortifying Paris, has had much to do with the shaping of its locomotive systems on a circular rather than on a radiating plan; and this has had the effect of curtailing the creation around Paris of innumerable suburbs similar to those which have grown up around London under a system which was not subject to any such political or military restrictions. The Paris municipality's concern to isolate their system is shown by their attempt to adopt the narrow metre gauge, so as to lessen first cost, but also to render it impossible to connect the Metropolitan with the main lines, which the Government, however, altered to the standard gauge (4ft. 8½in.). Still, isolation has been completely effected by the adoption of a reduced cross-section for the tunnels, which will prevent the standard rolling stock of any of the main lines from passing through them, though not hindering the Metropolitan's carriages from travelling upon the main lines, should such an arrangement be hereafter desired. The scheme embodies a circular system of underground lines, numbering eight in all, in shallow tunnels worked by electricity, of a length of 38·86 miles, embracing, of course, the centre of Paris. The cost of construction is estimated at £12,000,000, which is being undertaken by the Municipal Works Committee. Begun in 1898, 1900 witnessed the opening of the first section, contemporaneously with the inauguration of the Central London. In 1903, the fifteen miles then opened carried 102,000,000 passengers. This, in spite of the shock of the serious accident, increased to 117,550,521 for the year ended December, 1904. To date, including Line 3 just open, some twenty miles are in operation. While the Paris and Central London systems present features in common, they differ in other respects. According to a report by Col. Yorke, of the Board of Trade, the Paris Metropolitain is constructed as close to the surface as possible, while the Central London is from 80 to 100 feet below the street level. The Metropolitain is in masonry, the Central London is in iron tube; the one has both up and down lines side by side in the same tunnel, the other has each track in a separate tube, which, you will recall, the King on the opening of the City and South London said he regarded as a "great advantage." Line 3 of the Paris Metropolitan Railway has just been opened, and runs from the north-west of the city, skirting the Gare St. Lazare station and passing the Opera to the Place Gambetta. As you will see from the map, it divides the irregular ellipse formed by the first two lines, serves the central boulevards of the city, and adds five miles to the fifteen miles of the system. The southern portion of Line 2 is partially in operation, and is almost completed, and only awaiting the two bridges over the Seine, one at Passy and the other close to the Pont de Bercy. With this completed, the Metropolitan of Paris will be very much like the London Inner Circle with the Central London and Brompton and Piccadilly crossing the circle east and west, while the north and south section to be constructed may find their counterparts in the Waterloo and Baker-street and Strand, Euston and Hampstead. The popularity of the Metropolitan is confirmed, in a negative way, by the

disastrous effect it has had on the receipts of that great monopoly, the Paris General Omnibus Company. The dividends of this company have disappeared, and the undertaking has been compelled to discontinue many of its lines and to sell a portion of its real estate property. Owing to the disorganisation of the omnibus company and the failure of several electric tramway companies, the traffic problem of Paris has assumed such a serious aspect, that the Municipal Council has been forced to take steps to alleviate the present condition of affairs, notwithstanding that the omnibus monopoly does not expire until 1910. The Traffic Committee, which was appointed to investigate the question, has drawn up a plan according to which the omnibus concession is to be renewed for 30 years after 1910, but on the condition that the company abolish the present horse omnibuses in operation, and replace them by mechanical traction. The proposal has been accepted by the Municipality, and has created a favourable impression in Paris. In London or New York the underground electrical railways, so far, have had very little effect on surface methods of transportation, which, however, does not seem to have been the case in the French metropolis.

Berlin's Elevated or Subway.

Beginning, as we have seen, with the Ringbahn or Circle Railway opened in 1877, and built with little or no regard for public convenience, the City of Berlin ten years later, or in 1888, opened the Stadtbahn, and the need of it was indicated by, for example, the statistics of 1900, which show that whilst the Ringbahn, with a much larger mileage, only carried 37 millions, the Stadtbahn carried 60·5 millions, and at the present time probably carries double that number. More interesting, perhaps, as showing the development of rapid transit in Berlin, is the new Electric Elevated and Underground Railway, seven miles in length, which passes over areas enclosed in the three municipalities of Berlin, Schoenesburg, and Charlottenburg. After overcoming many difficulties with these municipalities, and obtaining both the consent of the Government and the Sovereign, the work was put in hand in 1897, and in the beginning of 1902 the line was opened, the contractors guaranteeing a dividend of 4 per cent. The following year the owning company took over the working, and was able to pay a dividend of 3½ per cent., the traffic increasing 10 per cent. over 1902. Here also the municipalities had a finger in the pie, each of them securing a percentage of the annual receipts for the right of way. The line is mostly elevated, but some of it inclines into shallow subways. As an interesting combination of an elevated and subway railway, it is a striking example of engineering ingenuity. To Berlin, by the way, must be given the credit of inaugurating the first electric railway ever put into real service—the line of the Berlin Industrial Exhibition of 1879. But it is on the tramways and omnibuses that the Berliner relies for getting about. These in 1900 conveyed no less than 390 millions. It must be remembered that Berlin is peculiarly a tramway and omnibus city, coming into existence, as it were, during the tramway period, and hence its streets were more easily adapted to this mode of locomotion than the narrow tortuous ways of older cities. Few people realise in speaking of Berlin that not only has it had a higher average rate of growth in area than any other European city, but between 1861 and 1900 it shows an average annual increase in population of about 3½ per cent.; while the increase of the territory which now constitutes Greater New York during practically the same period (namely, between 1870 and 1900) has been 2 8-10ths per cent. per annum. During the same period (1861-1900) the average rate of increase of the population of London has been little less than 1½ per cent. In short, one might go on multiplying these radical differences in communities until all comparative studies of the question would be dismissed. The fact is that London is so unlike any other city in its growth and system of government, and its surroundings are so unique, that what applies to it does not apply (to any great extent) to other cities of the world.

The Building and Growth of London.

Before further considering the underground electric railways of London, I would call attention to four very interesting maps showing the stages of their growth. These maps were originally prepared by Mr. R. W. Perks, M.P., the chairman of the Metropolitan District Railway, and submitted to the Royal Commission on London Traffic by him in the form of large charts. I might mention that the Royal Commission and Mr. Perks kindly allowed me to make use of these maps in an article in "Traction and Transmission," a supplement of *Engineering*, and the slides that we have to-night are made from them, and are used at this meeting by the permission of the editor

of *Engineering*. The preparation of these maps has involved a great deal of labour, and the engineers who had charge of the work had to make elaborate investigations in the British Museum Library in order to ascertain from old maps the built-up portions of London 60 years ago. The idea was to show the built-up portion of the metropolis at four periods, namely, 1845, 1860, 1880, and 1900. To overcome the change in area during the period under consideration, the Administrative County of London, created in 1889, has been adopted, and is shown on each map by a light red colouring bounded by a full red line. Within this boundary the population and railway mileage has grown as follows:—

Year.	Population.	Miles of railway.
1845	1,949,277	29¾
1860	2,808,404	69¼
1880	3,830,297	215¼
1900	4,536,541	248½

The small increase in mileage between 1880 and 1900 will be remarked.

The figures, however, only represent the route mileage in each case. The track mileage, in which there has been a great increase (some of the railways having multiplied their tracks running into London five and six times in this period) is not shown. Had it been possible for the engineers who prepared these maps to have shown the increase of track mileage by the increased width of the line, an even more comprehensive idea would have been given of the railway extension in the county of London. I might say, however, that the length of railways for conveyance of passengers in Greater London in 1903, including the tubular lines in course of construction, was 630·3 miles; but of course the figures for the area covered by the administrative county of London are not nearly so great.

In these maps we see London as it appeared to our fathers in the early forties, with its population touching the 2,000,000 point, and its railways timidly approaching the central districts. In 1845, only one railway, the Great Western, was known by the same name as it is to-day and had the same terminus—Paddington. The London and South Western was known as the South Western Railway, and its terminus was Nine Elms. The South Eastern and Chatham and Dover entered London at Bricklayers' Arms Station as the Dover Railway, and took its exit as the Croydon Railway. From London-bridge Station ran a short railway to Greenwich, and from Fenchurch-street another short line to Blackwall. Shoreditch was the terminus of what was known as the Eastern Counties Railway and the Northern and Eastern Railway. Euston existed, but not as the terminus of the London and North Western Railway, as that system was known by the less pretentious title of the Birmingham Railway, with a small branch called the West London Railway, and a station at Addison-road. The number of railway stations in London 60 years ago was eight, namely, Euston, Paddington, Addison-road, Nine Elms, Bricklayers' Arms, London-bridge, Shoreditch, and Fenchurch-street. To-day there must be nearly 300. Think of London without Waterloo, King's-cross, Charing-cross, Liverpool-street, Victoria, Cannon-street, Baker-street, Marylebone, and a score of other less important centres of traffic! From the period immediately preceding the Great Exhibition at the Crystal Palace, we come to 1860, during which time Waterloo and King's-cross make their appearance, and the line mileage more than doubles, aggregating nearly seventy miles. Between 1860 and 1880 the railway mileage nearly quadrupled, and for the first time a network of lines appears in the centre of London. During this period the underground railways were born, the North London extension was built, and the stations of St. Pancras, Baker-street, Bishopsgate-street, Liverpool-street, Charing-cross, Victoria, and Cannon-street appear. Offshoots, and curves, and loops and circles, with here and there junctions, too complicated to be clearly shown on the maps, now completely cover what in 1845 and 1860 seemed an open area, and one is now plunged into the inextricable maze of London transportation. Another feature of the third map of the series is the growth of Greater London. It would be impossible to compare impartially the map of 1860 with the map of 1880, and declare that the railway companies entering London have not tried their best to meet the increasing requirements of London's growing population. A careful study of these two maps will make clear a good many questions which are so often dealt with in a superficial manner by those who imagine they can sponge out the network of railways and begin the work of reconstruction, whether on the map of 1845, or even on that of 1860. It is well to remember that the Royal Commission is dealing with even a more complicated map than the one of 1880, for since then tubular railways and elec-

tric tramways have appeared on the scene, which have come to stay. The growth between 1880 and 1900 has been, as far as the fourth map of the series goes, one of population rather than of railway route mileage. The actual mileage of track has undoubtedly increased, but the slight increase of thirty miles of route mileage shows what is very apparent, when glancing at the map of 1880, that the routes into, across, and around London had then been pretty well appropriated, and that the only possibility left for railway extension was underneath London. It is fair to assume that if surface railway extension had been possible during this period, it would have been made. The railway companies have been obliged to confine themselves to the increase in the number of tracks and of trains, and the enlargement of their carrying capacity, by larger carriages and longer platforms, and this shows that the limit of surface lines has been reached. Indeed, with the establishment of the Great Central's terminus at Marylebone, there seems no possible loopholes for new entrances to London, so completely is the inner circle surrounded by railways and public roads. For this reason, and not from lack of enterprise, has surface railway development been brought to a standstill, while modern enterprise and engineering have given their attention to the possibilities of the further developments of underground electrical railways.

London Essentially a Railway City.

London is essentially a railway, not a tramway city, and this assertion is made with a knowledge of the fact that the tramways in and around London conveyed in 1903, 361 millions of passengers, nearly as many as Berlin, which I have called a tramway city. There are in London and extra London 531 railway stations, and with the opening up of the new tubes, this number will be increased to upwards of 600. The length of the trunk lines, local lines, local joint lines and tubular lines (including those soon to be opened) in Greater London exceed 630 miles, this giving nearly a station to every mile of line. Of these stations 22 only may be regarded as termini —Moorgate-street, Mansion-house, Liverpool-street, Bank (Central London), Broad-street, Victoria, Angel (City and South London), Waterloo, London-bridge, Fenchurch-street, Bank (Waterloo and City), St. Paul's, Ludgate-hill, Snow-hill and Farringdon-street, Charing-cross (South Eastern and Chatham), Baker-street (Metropolitan), Cannon-street, Holborn-viaduct, Paddington and Bishop's-road, St. Pancras, Euston, Shoreditch, and Marylebone. Into these termini pour daily 4,252 suburban trains, and 445 other trains, making a total of 4,697. The same number must go out at night and during the day. The relief tubes and underground railways afford the streets is apparent when it is realised that the Central London trains of seven coaches can carry as many passengers as thirteen omnibuses. As 337 Central London trains run to the Bank every day, that is equivalent to 4,381 omnibuses. But the trunk lines, notably the Great Eastern, have even a greater capacity. The main difficulty in London, as all witnesses before the Royal Commission seemed to agree, was to get the passengers from the scattered termini to their work and business, but that will be remedied in a large measure by the new tubes, with their 52 new stations, and as many new connections with existing underground railways. Electrification of these local lines, and separation as far as possible from trunk line traffic will likewise increase the number of trains, the carrying capacity, and reduce expenses. Four-fifths of the half million of passengers brought into the central area of London up to 10.30 every day are conveyed by railways and one-fifth by tramways. Acting as distributors and feeders of the trunk lines the railways operating in London (undergronnd and surface) carry not less than 600,000,000 passengers per annum. Of this number the District, Metropolitan, North London, City and South London, and Central London last year carried 258,000,000 passengers. To this we must now add 14,000,000 for the Great Northern and City, making a total of 272,000,000. The new accommodation now in course of construction will provide facilities that will much more than duplicate these figures. The Great Northern, Piccadilly, and Brompton will provide a carrying capacity of 116,000,000, the Charing-cross and Hampstead 95,000,000, the Baker-street and Waterloo 116,000,000, and with another 100,000,000 for the electrified District and Metropolitan, and their improved extension and greater facility for passengers to exchange, will practically give greater facilities ranging from 400 to 450 millions additional passengers per annum. These estimates may seem rather large, and the whole system will have to be working harmoniously before the number of passengers will reach the full capacity; but judging by the history of existing undergrond railways, those now in course of construction

will be fully utilised. Mr. Cuningham, the General Manager of the Central London, told me the other day he was averaging over 150,000 passengers per day, and I should not be surprised to see the total for that railway reach 60,000,000 per annum, and this on a line of six miles. He is now running at a two minutes headway, but under certain conditions this could be reduced to a 1¾ headway. The headway in the New York Subway and tubular railways is one minute headway—so 1¾ would seem to be safe.

Here is a significant comparative statement of the traffic of the City and Sonth London :—

City and South London Railway.

Comparative Statement for Half-years ending June, 1891 *and* 1904.

	June, 1891.	June, 1904.
Length of Line	3 miles, 12 chains	6 miles, 9 chains
Train Mileage	174,435	589,401
Receipts	£19,688	£80,204
Working Expenses	£15,521–79 per cent.	£36,569–45·58 per cent.
Number of passengers carried	2,412,343	10,225,987
Or about	5,000,000 per annum	21,000,000 per annum
Dividend	Nil	2½ per annum.
Number of carriages	30	142
Number of locomotives	14	52

I am indebted for the above to the General Manager of the company, Mr. T. C. Jenkin, to whom the successful growth of the company's traffic is due. He has been associated with the undertaking from the opening, and by a progressive policy has, from a comparatively unimportant beginning, brought the business of the railway to its present position. The mileage of this railway has been doubled, but its receipts, and the number of passengers carried, have been more than quadrupled. The trains are now, during rush hours, running every 2½ minutes, and the daily number of trains is about six hundred. When the extension to Euston is completed, and the numerous connections with the other tubular railways are in operation, the traffic on this line will, in my opinion, reach at least 30,000,000 per annum. The 3½ miles of Great Northern and City Mr. Francis Fox informed me will reach 14,000,000, and when the extension to the Bank is finished, as it must be, this little tube will carry 20,000,000, the original estimate. Surely 30,000,000 is not too high for the City and South London when completed. The present line links up with the Brighton, and South-Eastern and Chatham, at London-bridge, the Baker-street and Waterloo at the Elephant, the Central London and the Waterloo and City at the Bank, and the Great Northern and City and Metropolitan Railways at Moorgate-street; and when the additional extension to King's-cross, St. Pancras, and Euston is completed (powers for which were obtained in 1903), it will link up, by means of subways, the stations of the Midland at St. Pancras and the Great Northern, and Great Northern and Strand at King's-cross, and by subways and lifts the platforms of the North-Western, and also the Hampstead and Charing-cross Railways at Euston.

The question will naturally be asked, will the ever-increasing traffic of London at once absorb all this new accommodation? The answer, I think, is that it will, as rapidly as the accommodation is ready for use. The American metropolis, with a capacity for carrying 1,200,000,000 passengers per annum, is preparing to carry 2,000,000,000 passengers, but experts in that city believe that in less than ten years from the completion of the present facilities the requirements will be 3,000,000,000. In both cities, what may be called the travelling habit, increases with the increase in the convenience and accommodation of the means of transit. The number of journeys per head of population has increased in a generation in London from 23 to 200 journeys, and in New York from 47 to over 400 journeys per head of population. But assuming that it remains the same in London, and then it will be seen that with 1,000,000 increase in population each decade, there will be an addition of 200,000,000 possible customers for the various means of locomotion. Thus, while these new tunnels have been in course of construction, 100,000,000 new customers have come into existence and are waiting to be carried.

Metropolitan and Metropolitan District Electrification.

The work of electrifying both the Metropolitan and Metropolitan District is proceeding very well, and both these systems have had "openings;" the former is now running an electric service between Baker-street and Uxbridge, and the latter electric trains between Mill Hill-park and Harrow. The line on the District from Hammersmith to the City will come next on the District, while Mr. Ellis, General Manager

of the Metropolitan, tells me that to avoid dislocation of traffic the electric trains will be introduced gradually. In short, these two railways will be completely transformed, and as a result the managers may look forward to a decided increase of passenger traffic. I shall append a few facts in relation to this work which will give some idea of the magnitude of the task of changing, for working by electricity, an ordinary gauge railway (constructed underground) carrying heavy passenger and goods traffic hauled by steam. The equipment in both instances will necessitate very considerable alterations in the permanent way, and as progress in the preparation of the road for laying cables, conductors, and insulators has to be made whilst the trains are running, and without causing interruption to the traffic, it will be seen that the difficulties to be contended with are very considerable, and of greater magnitude than would be the case in the construction of a new railway for working by electricity. The Metropolitan Company's generating station has been erected on land adjoining their engineering works at Neasden, London, N.W., and the work of installing the machinery is rapidly progressing. The site is admirably suited for the purpose, and its area sufficient to meet considerable extension of the power station. An abundant supply of water for all the requirements of the generating station has been found by sinking two artesian wells to a depth of over 400 feet. Advantage will be taken of the power to drive the machinery in the locomotive engineering works by electricity, thereby enhancing their manufacturing capacity, and electrical energy will also be available for lighting the whole of the company's works and station premises. The power station will be the most extensive in the kingdom owned by a single railway company; the main building covers an area of 3,570 square yards, or 318 feet long by 101 feet wide.

Transmission of Electric Power.

Another of these tremendous generating stations, very similar in construction, only larger, has been erected on the banks of the Thames at Chelsea, by the London Underground Electric Railways Company, which will furnish electrical power for the Metropolitan District Railway, and also for the new tubular railways under construction, of the London Underground Electric Railways Company. I visited this manufactory of power the other day, in company with one of my friend Mr. Thomas's artists, whose excellent drawings from the *Graphic* we reproduce on the screen. There I found on the banks of the River Thames, alongside of a muddy disused canal, in the prosaic neighbourhood of Lot's-road, Chelsea, a structure which fairly bristles with force and power. Its four stupendous chimneys, each towering 75 feet higher than the Monument of London, give some indication of the power required within the structure. The actual dimensions of the building itself are greater than those of St. Paul's Cathedral, namely 454 feet by 174 feet, and 140 feet in height. If cut in two and placed lengthwise, the Chelsea power-house would resemble an ocean steamer longer by 200 feet than those of the *Celtic* and *Cedric* type, but whereas the ships would have large spaces devoted to passengers, cargo, crew, dining saloons, and so forth, the structure I am describing is all a huge power-producing machine, probably the largest ever constructed at one time. Within and around this colossal building of steel and brick every inch of space is utilised, and when the fires are lighted and the machinery put into operation, the movement will be from start to finish automatic. It will be under human direction, but that is all.

The Chelsea Power Station will have to furnish power for several railways and convey it fifteen or twenty miles. This latter experiment (though it can hardly be called that) is being looked upon by railway men with considerable interest, as the question how far power may be economically conveyed by electricity is one of considerable importance. On this question Mr. Ralph D. Mershon, speaking before the American Institute of Electrical Engineers on ths subject of the maximum distance to which power can be economically transmitted, says:—

> "The elements which, in the broadest sense, limit the distance to which power can be economically transmitted are two; the cost of the power at the generating station, and the price which can be obtained for the delivered power. The difference between these two elements must cover the cost of transmission, the interest on the investment and the profit. The cost of transmission comprises the loss of power in transmission, the cost of operating and the cost of maintenance and repair."

Mr. Mershon further gives a curve showing the net profit for different distances of transmission assuming that power can be purchased or produced at £2 5s. 6d. per kilowatt, and sold at about £7 per kilowatt.

Taking the case that we wish to make 12 per cent. profit, we deduce from the curve that—

25,000 kilowatts	can	be	transmitted	110	miles.
50,000	,,	,,	,,	225	,,
100,000	,,	,,	,,	350	,,
200,000	,,	,,	,,	525	,,

One of the largest power transmission schemes is that of the Niagara Falls, which supplies electricity to New York 450 miles away. The amount of power used by the large plants in that city is approximately 175,000 kilowatts. Another large plant is that of the Washington Water Power Company, the transmission line of this system being 100 miles. A few of the large power distribution schemes in Great Britain are: the Cleveland and Durham County Electric Power Company, the Clyde Valley Electrical Power Company, Derbyshire and Notts Electric Power Company, South Wales Electrical Power Distribution Company, and Yorkshire Electric Power Company. The area which these six companies alone are to serve amounts to over 7,000 miles, with 19 power stations, most of which are now in course of construction. In comparison with these enterprises there would seem to be little doubt that the large power-houses of the Metropolitan and the London Underground Electric Railway will do the work required of them easily and efficiently. There are beside these two the splendidly equipped power-house of the London Central Railway, the one at Chiswick operating the London United Electric Tramways, the fine new one partially finished, I believe, at Greenwich for the London County Council's South London Tramways sytem, the new power-house of the North Metropolitan, and of course the Great Northern and City, the City and South London, and the one operating the Waterloo and City. The Great Western Railway Company is also building a large electric generating station at Park Royal; and while this railway has not committed itself to the electrification of its suburban railways, it will, as joint owners with the electrification of the Hammersmith and City, have to adopt electric traction on this part of the system. Under a new Act of Parliament railway companies have the right not only to contract for such power, but to produce it themselves, convey it along their own way-leaves, and sell it to manufacturers, mine owners, or others requiring power for any purposes whatever.

In the aggregate, all this work, with the traction improvements which they carry with them, exceeds in point of capital expended the similar work now in progress in New York under the supervision of an active and capable Rapid Transit Commission. Yet oddly enough London has a Royal Commission at this moment in session investigating with great care and deliberation with a view of determining what shall be done, a fact which once more indicates that London is like no other city.

THE WATERLOO AND CITY.

The second tubular railway in London was the Waterloo and City, a small tube running from Waterloo Railway Station under the main terminus of the London and South Western, and reached by inclined plane, to the Bank. This line was projected under the auspices of the South Western, for the purposes of relieving Waterloo Station of its suburban passengers, and discharging them in the City. It has been very successful, and passengers can exchange with the City and South London, the Central London, and the Great Northern and City, a most useful north and south connection. The Waterloo and City is also arranging for connection in the same way with the new Baker-street and Waterloo, which will enable passengers to pass direct from Waterloo Station to St. Pancras, King's-cross, Euston, Baker-street, Great Central and Paddington. This little tube, about a mile and a-half long, has been most successful; it not only pays very well as an investment, but last year four and a-half million fare passengers, and about one and a-half million season ticket holders, in all six million passengers, travelled by it.

THE "TWOPENNY TUBE."

The Central London Railway, or the "Twopenny Tube," as it has been popularly christened, was the third tube opened, and by reason of the fact that it is located under some of the most important arteries of London from Shepherd's Bush, being under Bayswater-road, Oxford-street, Holborn, Newgate-street, Cheapside, to the Bank, it is the best known of the London tubes. It is about six miles in length at present. The selection of this route was wise, because it runs through the very centre of London traffic, and converges at the Bank, where 774 vehicles pass each hour of the day. It passes under Oxford-street, which then could boast more traffic—running 550 vehicles an hour—than any other street in London; and it has a station at Oxford-circus, which ranks fourth in the list of points of greatest traffic, Piccadilly-circus,

Charing-cross and the Bank only exceeding it. The Central London has another station at the junction of Oxford-street and Tottenham-court-road, where 500 vehicles pass per hour. At the time this tube was projected, the thoroughfares under which it runs were found to be the routes of greatest traffic, and are probably so to-day. A more recent census of traffic shows, however, that what is called Piccadilly and Charing-cross route from Hammersmith to the City has a greater traffic now than the Oxford-street route had ten years ago. The fact that the Piccadilly route is even a better one, together with a four per cent. dividend, undoubtedly prompted the active competition of both the Central London and other companies for new lines along this route to the City.

It will not be amiss to refer here to the ventilation of the Central London tube. It must be admitted that tube ventilation is a very important matter, and one that is being seriously considered by engineers on both sides of the Atlantic. A well-known consulting engineer remarked to me the other day that the subject was so important and attracted him so much that if it were not for the financial necessity of conducting a general practice he would give it all up and devote his life to an attempt to solve this problem of tube ventilation. The Central London has done very much to improve the air of their tube. They have a large fan, which works at Shepherd's Bush, and draws the air out from the Bank through the tube the whole distance every night. This fan is sufficiently powerful to clear the air out twice over during the three hours when the traffic is stopped. In the day time, of course, there is a great deal of natural ventilation carried on by the motion of the trains. Mr. Granville C. Cuningham, General Manager of the Central London, told me in a talk I had with him the other day that he thought they had greatly overcome the difficulty of imperfect ventilation. The chemical observations made of the air in their tube show that it is by no means bad; there is, of course, the peculiar smell in the tunnel, which, though very difficult to account for, cannot in his opinion be attributed to bad air. The carbon dioxide that has been measured by the chemical observations is not large in the Central London tube as compared with other tubes, and the bacteriological observations give results that are even better than in the street. The chief objection, no doubt, is the smell in the tunnel, and this is said to be entirely due to the earth. It is to be remarked, however, that the smell is much less in the South London tube, but why this is so it is difficult to say. Mr. Cuningham is hopeful that as their experience increases the difficulty will be obviated. There might, for instance, be a system of horizontal tunnels adopted, running out from the middle part between the stations back to a distance, into a back yard, where a vertical shaft might be built, and a fan placed in that shaft running constantly, which would draw the air out of the tunnels while the trains were running. If such a plan were carried out during construction, it would, Mr. Cuningham thinks, form a very perfect system of ventilation. While I was in New York, this question of ventilation was raised in relation to the subway, but it seemed to be very well ventilated. Indeed, extensive tests as to the condition of the subway from a sanitary point of view, especially as to the purity of the air, were made by Professor Charles F. Chandler, the eminent scientist of Columbia College, at the request of the Health Department of the City of New York. According to this authority, the air in the subway is dry and pure, has not in any case suffered any serious loss of oxygen, and is for all practical purposes quite equal to the air of the streets as far as health is concerned as dependent upon the percentage of oxygen.

The constructors of the new tubes have given very careful attention to this matter of ventilation, as well as protection against fire. We have been assured both by Mr. Yerkes and Mr. Edgar Speyer that the additional cost involved in consequence of the Underground Electric Railways Company's desire to increase the comfort and safety of the travelling public has been large, namely, the use of concrete platforms, non-inflammable carriages, and all the latest and most expensive devices for the safety of passengers and the comfort of travelling. The cost, we have been told, has not been considered in obtaining the latest inventions for this purpose, and as far as human ingenuity could foresee, their cars, equipment, and the whole new system now being constructed are fireproof. For example, they have had the wood for portions of the cars treated by a special process to render it non-inflammable.

The precautionary measures, at the start, bear out the opinion of Mr. Cuningham, General Manager of the Central London, who, in his evidence before the Royal Commission, stated that the matter of vital importance in all tube railways was that the question of fire pro

tection should be attended to from the very first. It appears that on this tube they have had small fires in the tunnels and trains, but having appliances for dealing with them, they have been put out at once.

Attention has been turned of late to steel-framed and steel-plated cars, and it may be of interest to know that for the past eighteen months six cars of this style, built to the designs of Mr. Cuningham, have been running most satisfactorily on the system. The frame is steel; outside panelling thin steel plate; roof, sheet steel, lined with asbestos millboard. The advantages of this car are—(1) lightness and rigidity; it is 12 cwt. lighter than an ordinary car; (2) non-liability to fire; (3) greater internal space; owing to the thinness of the walls the car is 4½ inches wider inside than the others, the outside dimensions being the same. Similar precautions will be taken by the projectors of the new tubes.

Great Northern and City.

Returning to our list of tube railways, we come to the Great Northern and City, which was next opened after the Central London, in the early part of 1904. The line runs from Finsbury-park to a station at the junctions of Moorgate-street, Princes-street, and Lothbury. It is, of course, as yet in its infancy. While the traffic of this tube did not meet expectations when it was first opened, it now seems to have a satisfactory working arrangement with the Great Northern, and it is rapidly becoming a popular and important branch of the tubular system of London. More than a year ago I estimated that the traffic on this line when completed to the two points above mentioned would not fall far short of 20 millions. At first when it opened this figure seemed not likely to be reached, but as the Great Northern and City will carry this year 14 million passengers, it is by no means improbable. It is one of the most popular of all the tubes, because of its extra diameter, and the comfortable carriages, and the fact that it runs into the open, which gives it perfect ventilation. The power-house is most conveniently located at Poole-street, on the banks of the canal, where, it being easily accessible for coal and water, the cost of power has been very cheap. This tube is connected with all the other tubes operating in London, not physically, but by aid of passage ways. The traffic will further increase as the public realise the importance of this connection, and as tubular railways extend.

The New Tubular Railways.

The new tubular railways which the London Underground Electric Railways Company are building are rapidly nearing completion. The map from which the slide is made, and which shows all the tubular railways of London in operation and under construction, was prepared especially for this paper by Cook and Hammond, the well known lithographers (*see* p. 249). The Baker-street and Waterloo will be completed, Mr. Yerkes hopes, in the coming summer, the Great Northern and Brompton later in the year, and the Charing-cross and Hampstead early next year. In an enterprise of such magnitude there may of course be unavoidable delays in the delivery of machinery and the completion of work, but the company has its finances well in hand, and the capitalists behind the undertaking are capable of finishing the work and operating the lines in the most approved manner. To begin with, these tubular lines will give London more additional stations than the subway just completed will give New York. The stations will materially aid passenger transit, not only east and west but north and south. Thirty of them are located in the congested districts. Starting from Charing-cross, one will be able to go *viâ* Cranbourn-street, Holborn, Russell-square, to King's-cross, and thence *viâ* York-road, Caledonian-road, Holloway-road, Gillespie-road, to Finsbury-park, the terminus of the Great Northern and City. From the same starting point (Charing-cross) one may go north *viâ* Oxford-street, Goodge-street, Euston-road, to Euston Station, thence to Camden Town, where the passenger may branch off eastward to Highgate, westward to Hampstead, Golder's-green, and thence on to Edgware. Again, starting from the embankment at Charing-cross-bridge, the passenger may go *viâ* Trafalgar-square, Piccadilly-circus, Oxford-circus, Regent's-park, to Baker-street, and from thence *viâ* Lisson-grove, Edgware-road, to Paddington. Returning from Paddington to Piccadilly-circus, the new tubes will take him under the river to Waterloo Station, and thence on to the Elephant and Castle. From Holborn, Strand, Covent-garden, Charing-cross and Trafalgar-square, the new lines will run westward *viâ* Piccadilly-circus, Dover-street, Down-street, Hyde-park-corner, Knightsbridge, Brompton-road, South Kensington, Gloucester-road, Earl's-court, Baron's-court, to Hammersmith-broadway, which, in conjunction with Shepherd's-bush, comprise the two great western gates of modern London.

LONDON UNDERGROUND ELECTRIC RAILWAYS

Under the new schedule which will be put in force, the Underground Electric will, in conjunction with the District Railway, run from Hammersmith to Piccadilly in 20 minutes, and from Piccadilly to King's-cross in 10½ minutes, so that a passenger would be able to travel from Hammersmith to King's-cross in 30 minutes by the tube railway, at a cost of 2d., if they put on a uniform rate. From Charing-cross it would take 10 minutes to go to Euston, and the charge would be 2d.; and from Charing-cross to the Midland Station at Kentish Town the time would be 15 minutes. From Charing-cross to Highgate and Hampstead would be 19 minutes, so that if a person wanted to go to Hampstead from Westminster, he might get into a train at Westminster Station, change at Charing-cross, and be at Hampstead in 19 minutes from Charing-cross, with an addition, perhaps, of three minutes, from Westminster. At Charing-cross he could also change into the Baker-street and Waterloo trains, and be at the Elephant and Castle in eight minutes, or, travelling north, reach Baker-street in ten minutes, and Paddington station in 15 minutes. The time from Hammersmith to the Mansion House will be 26 minutes; from South Kensington to the Mansion House, on the main line, 16 minutes, and from Hammersmith to Bow, 39 minutes. When the deep level is built for fast trains, there will be no stops between Hammersmith and the City, excepting probably at South Kensington, Victoria, and Charing-cross.

This unrestricted method of exchange between these tube railways and the District will be a great advantage to the travelling public, and even greater if the Metropolitan Railway can be brought into the arrangement. The District is now laying down two more lines all the way from West Kensington into Hammersmith, where there will be terminal accommodation provided on the District Railway for the Brompton and Piccadilly line. When finished, which will be about a year from now, the Brompton and Piccadilly will start from a terminal dock in Hammersmith Station and run all the way to Finsbury-park. There will then be four lines instead of two on the District Railway from West Kensington to Hammersmith.

By the aid of the electrified District Railway, passengers will be able to go from Hammersmith straight away through to the City. Of almost equal importance to the new stations will be the connections with existing lines that these tubes will be able to make. Perhaps not at once, but with here and there additional connecting links, there will be formed a complete system. For example, the new tubes will cross the Central London at three points—Holborn, Tottenham-court-road, and Oxford-circus. They join the District at Charing-cross and Embankment, and the City and South London at Elephant and Castle. Including the District, which connects with Victoria, Cannon-street, London-bridge, and Liverpool-street Stations, the Underground Electric will connect with all the important passenger stations—Paddington, Marylebone, Baker-street, Euston, St. Pancras, King's-cross, Charing-cross, and Waterloo. These trunk line stations annually pour into London over 300,000,000 passengers, the greater portion of which number must be carried to the central districts. The Underground Electric enters important districts, as the above list of stations shows, where the traffic up to the present time has been almost exclusively worked by omnibuses.

The question has been asked, and not without reason, will these new tubular railways pay? Judging from what is now known of the electrical railways in operation I think they will. The twenty miles of underground and elevated railways in New York which have been opened but a few months are carrying 400,000 passengers daily, or over 150,000,000 annually. The Metropolitan of Paris, with its 15 miles, is carrying 120,000,000 annually. The total will be largely increased by its five additional miles just opened. The six miles of the Central London may exceed 50,000,000 passengers this year, while the other three tubes will indicate increased traffic which will advance further as connections improve. Based on the earnings of the Central London and on a passenger traffic of 55,000,000, the Baker-street and Waterloo should earn £230,000. The Great Northern, Piccadilly and Brompton, with a passenger traffic of 85,000,000, should earn £358,000, while the earnings of the Charing-cross, Euston and Hampstead line, with its 75,000,000 passengers per annum, should be in the neighbourhood of £316,000. With a common power-house the working expenses should be much less than 50 per cent. of the earnings, the Central London being just over 49 per cent. With the growth of London they will undoubtedly become profitable investments.

VIBRATION AND EFFECT OF TUBULAR RAILWAYS ON BUILDINGS.

Now and then we hear a sensational story that the tubes have caused cracks in some important public building, and when the Central London was started there was more or less complaint in relation to vibration, but this has been obviated by the removal of the heavy engines, and the use of smaller motors attached to the cars. I have given you an instance in Chicago, where the whole business part of the City had been tunneled, the top of the tunnel being only 24 feet from the surface of the street, without, even, in a great many cases, the knowledge of the occupants of the mighty sky-scrapers. As a rule these alarms have proved both foolish and false. One of the more recent has been with regard to St. Paul's Cathedral, the foundations of which were said to be sinking as a natural consequence of the borings going on for the tubular railways and the pumping which accompanies the work of driving the various tunnels constructed in its immediate vicinity, and others that were in progress. Then ominous fissures have been discovered in the fabric; the moisture in the gravel bed of London was said to have been drawn off by pumping for the various tunnels; lower water courses have been formed in every direction in which the tubes penetrate; engineers have failed in their attempts to hermetically seal the tubes to the clay, &c. As to the cracks in St. Paul's, these were shown on investigation to have been done as far back as 1835, during the construction of a deep drain. It is true these old cracks have been slightly reopened, but the construction of the tubular railways according to the best authorities cannot be blamed in the matter. With regard to the alleged result of pumping, another authority says it is most unusual to resort to pumping to any great extent. There are miles of tubes now in course of construction where he states not one drop of water has been.

To show how effectively tube and station construction underground can go on without danger to buildings above, I might instance the case of the church of St. Mary Woolnoth, situated at the corner of Lombard and King William-streets. Underneath this church, as you are aware, is the Bank Station of the City and South London Railway, in connection with their City extension to Moorgate-street. Talking with Mr. Basil Mott and Mr. David Hay who, with Sir Benjamin Baker, were the engineers of this extension to the City from the Borough, these gentlemen gave me an interesting account of how the City and South London put a new foundation to this—one of the oldest of London's churches. It was originally the intention of the company to acquire and pull down the church, but as some outcry was raised about demolishing what was considered a remarkable example of church architecture, the company agreed to leave it standing, and construct the station underneath. This entailed the removal of the whole of the old foundation, and the substitution of a steel table standing on massive legs to support the fabric, before the station works could be proceeded with. When this had been accomplished, a 72 feet long, 24 feet wide, and 100 feet deep shaft for five passenger lifts was sunk immediately below the building, with adjoining corridors at the bottom, and passages leading to the station platforms. A booking-hall was constructed under the street, from which a passage communicating with the waiting-hall had to be driven directly below the church tower. Mr. David Hay has been kind enough lo allow me the use of some slides showing how this difficult task was satisfactorily accomplished.

Slide 1 shows the plan of the station at booking-hall level, about 10 or 12 feet below the street. The lift shaft is seen extending right across the church, the oval booking-hall and passage below the tower communicating with the waiting-hall. The five lifts are together capable of raising 450 passengers at a time.

The second Slide shows a section through the centre of the shaft with the church overhead. You will notice the girders supporting the walls, roof, and columns and floor of the church—a weight of something like 1,500 tons. The elevators are also shown, some at top and bottom, and one halfway up. The tubes are shown under the street, also the staircases and passages to platforms, which are situated in large tubes a little further towards the river.

Slide 3 is a section through the booking-hall and lift shaft, and adjoining corridors for entrance to, and exit from, the lifts at the bottom. The lift machinery is also shown at the bottom of the shaft.

Slide 4 is a plan at bottom of shaft. It shows the corridors and passages leading to and from platforms, and also the electric lift machinery.

Turning to other parts of the railway, Slide 5 shows a view of a tube tunnel (30 feet internal diameter) in course of construction.

Tunnels of this kind are made at the Clapham-common and Islington termini. They are large enough for two lines of rails and an island platform. The engineer for this scheme, as opened in 1890, was the late Mr. J. H. Greathead, and it is needless to say what a debt of gratitude London owes to this gentleman in being the first to introduce in a really practical way a system which, to say the least, is one solution of the problem of London traffic. Mr. Charles Grey Mott has been chairman of the company since its inception, and it is not too much to say that to his ability, energy, and perseverance London owes a debt of gratitude for the introduction and development of electric traction on underground railways.

General Conclusions.

It has only been possible to review in this paper the progress of electrical street railway work in London, New York, Paris, Chicago, Berlin, and Boston. From the very inadequate manner in which I have touched upon these great industrial works, you will be able to gather that much is going on in this direction, and that the end of the work can only be when these cities cease to grow, or when the industrial centralisation of our own times changes to the industrial distribution which may come with the lessening in cost of power distribution. The extension of such enormous distribution of power as, for example, the Niagara electric plant, and the various power plants in course of construction in the United Kingdom, must distribute factories and shops over a wider area. Steam undoubtedly concentrated industry, and built up the large "coketowns" of the present day, while it is more than possible that the use of electric current generated in stupendous power plant such as those I have shown are now actually in operation, and in course of construction in London, New York, and other centres of industrial energy, will result in a migration of factories and workshops further afield. But some will say, possibly persons in this very audience, what right have these large cities thus to grow and increasingly demand these stupendously expensive machinery for getting about? I am perfectly aware, as most of you are, that there are some philosophers who contend that our modern cities should not require this rapid transit—that the great cities of the East, from Babylon to Pekin, appear to have grown up without the necessity of rapid transit. Indeed these people are enquiring whether, as in the case of London, the limits of its usefulness as a system of homes and trade settlements have not been reached. It is not my intention to go into the question of the centralisation of industry, nor the centralisation of amusements, nor of official, commercial, and artistic life. There is no doubt that the evidence taken before the Royal Commission on London Traffic has revealed a state of affairs most unprofitable to the railways, and most disastrous to certain sections of Greater London. We have seen this winter something of the evils of too cheap transportation in the sad conditions of affairs at West Ham, Tottenham, and other places in north-eastern London. How far this system of cheap fares is justifiable, and whether they should be abolished, I have no doubt we shall hear when the Commission reports; but I am clearly of the opinion that it will be far better for factories to move out of London, where industries could be carried on under more satisfactory conditions, than for the State to compel the railways to adopt such a schedule of fares as, for example, those of the Great Eastern, for the so-called benefit of the working classes. An admirable article by Mr. T. C. Elder on "The Movement of London," published in *Traction and Transmission*, contains this passage, which it is well to remember in discussing the future needs of London in rapid transit:—

> "There are a great many people in the metropolis who could probably be more profitably employed, and for whom there is more comfortable accommodation, elsewhere. Without asking where they come from the Government appoints a Commission to invent some means of enabling them to settle down at their ease, and to invite their friends and relatives to join them. So long as the machinery of State is set in motion to assist manufacturers in retaining their present position in the metropolis, so long will they remain."

This is a phase of the rapid transit problem that we do not hear much about from those constantly pleading for more facilities and cheaper fares, but it may indicate that if there is no finality to profitable rapid transit, there may be a finality to the demand for additional cheap facilities which robs one class of the community to subsidise another. It has been claimed by some, and not altogether without reason, that the virtual purpose of the Royal Commission on London Traffic is merely to seek some means of providing rapid transit for those who cannot afford to pay for it. If, instead of

accepting the fact as an indisputable proof that "such people are living and working under uneconomic conditions," the same amount of energy on the part of those in high authority was devoted to inquiring what would have for its results "the encouragement of that decentralisation which would appear to afford the only permanent amelioration of the conditions of town life," the outlook would be much more hopeful.

While the subject of this paper has been the Underground Electrical Railways of London and other large cities, I am in no sense an advocate of this system of transportation, and no other, for London. A complete survey of the subject involves the consideration of (1) street vehicles, (2) surface railways or tramways, (3) overhead railways, (4) shallow underground railways, (5) deep level railways, (6) deep level or tube railways for freight, (7) electrification of steam railways, (8) straightening and widening of streets and bridges, (9) construction of new thoroughfares and bridges, (10) improvement of regulation of traffic. All these methods have their place in the solution of the traffic problems of such a city as London. London has outgrown the period when the improvement of any one of these methods of dealing with the traffic can make a perceptible difference. As a matter of fact, and we all know it very well, while the Royal Commission has been taking evidence on all these points, and many others, such as suspended railways, mighty avenues running to all points of the compass, double deck streets, and circular roads around the whole metropolitan area, those in charge of the several existing methods of transportation have been industriously studying how they can improve, extend, and quicken their systems of transit. One witness, when asked by the Commission for his solution, answered very promptly, "London requires all the existing facilities." The omnibus, the tramways, the tubes, and the undergrounds all do their share in the working of such a mighty body as London. The important thing is to get these all to work in harmony. If the Royal Commission can suggest a plan to do this it will have amply justified its appointment and the time it has taken to reach its conclusions. The unification of these several facilities by some common ownership or consolidation of management must in my opinion be precedent to any really satisfactory or lasting solution of the problem. The hope for such a settlement lies in the joint use of tracks, of stations, of passenger exchange from one line to the other when physical connection is impossible, and, even more than all else, in electrification, with the important economies that must come in the joint use of power. It is the large electrical power-houses, which we have seen are going up in so many directions in and around London, that will bring these interests together. It is nice to have your own exclusive power-house, but when it is found that your competitor is obtaining his power cheaper because it is being shared by a number of other enterprises, there will be a consolidation of interests on the cohesive basis of mutual profit, and from that the step is short to harmonious management. In a country like England, where the interests of the public are so carefully guarded, there will be no possibility of monopoly, and the travelling public will receive a full share of the benefits of electrification in the reduction of the cost of operation which is sure to follow.

As to the merits or demerits of different methods of dealing with transportation, there is little to be said when dealing with a city like London, which requires them all, and where (with the exception of freight tunnels) all methods are showing commendable activity. London cannot afford to put all her eggs in one basket. Note how invaluable the tubes were during the recent foggy days; in the spring and summer, what a boon to many are the upper decks of the tramways. For short distances there are omnibuses, soon, let us hope, to be converted into motor road cars. For long distances there are, or will soon be as I have shown, to a very much greater extent, the undergrounds and electrified street railways. And when each of these various methods of improving London is striving with considerable energy to increase its capacity, to improve its speed, and to make passengers more comfortable, or even to reduce or unify fares, it is only just that such activities should be recognised, even if it should be regarded as impolitic to add a word of praise. The battle for the London tubes seems to have ceased since the appointment of the Commission, but the Bills deposited for the coming Session indicate that capital is still forthcoming to link up and extend London's underground electric railways. The discussion of these new proposals involves controversial questions upon which it is not my purpose to enter.

Turning, therefore, to what is actually being done to relieve London, what do we find? The large extension of tubes and electrification of

existing underground railways and connections involving the expenditure of £25,000,000, perhaps £30,000,000 sterling; the extension, linking up and electrification of tramways by the London County Council in South London and similar work by the North Metropolitan in North London; the important subway connection for these two systems of surface railways—an enterprise in itself—that in a smaller city would attract a world-wide attention; the continued extensions of the London United Tramways in the western part of London. The Great Eastern and London and South Western, to say nothing of the three important northern railways, London and North Western, Great Northern, and Midland, are doing much that is wise and helpful for the suburban traffic. Independent of railway work the bridge building projects, the straightening and widening of thoroughfares such as the Strand and Fleet-street, and Piccadilly improvement, would form the subject of a paper as formidable as the one I am about concluding. Here we have the same idea in view—the relief of congested London. It is being carried out by the London County Council with great skill, and must prove permanently beneficial. Added to this and on the outer rim of the metropolis there are the steam lines which cut a far greater figure in what may be termed the street railway work of London than is the case with similar railways in other large modern towns. The work of electrification, as we have seen, has started: the Metropolitan and Metropolitan District have actually inaugurated electric trains on suburban lines; the London Brighton and South Coast have decided to electrify from Battersea to Peckham Rye, while the Great Western Railway proposes an extension from Ealing which will tap both their High Wycombe and Windsor lines, and bring passengers down to a new station at Shepherd's Bush, thus relieving both Paddington and Bishop's-road Stations. The completion of the Great Western and Great Central Joint line will add another new track to the many trunk lines entering London, and build up another important and almost untouched section of surrounding country. With the development of the single phase motor, which has made great headway within the last two years, there is no longer any necessity for a third rail, for a single small high-tension overhead conductor may be safely used instead. This will greatly simplify and cheapen the construction of electric railways, and enable the great railways which have in the past done so much to provide cheap and even rapid transportation into the surrounding districts of London, to retain their present share and to increase largely the speed and facilities for handling passengers. In this category we find the North London, the London Tilbury and Southend Joint, the East London Joint, the London Brighton and South Coast, and London and South Western Joint, and sundry other extensions and connections. These steam railways, after breaking through say a twenty mile radius around London, cross and recross each other in such a complex network of lines that they all become hopelessly merged into one system, handling together hundreds of millions of passengers annually, yet separately they are so unobtrusive that the traffic is not recorded but merged in that of the several railways operating them. This tangle of lines, with several hundred stations all within the limits of the county of London, is at the present moment facing the question of electrification. In ten years these lines, in my opinion, will be electrified and operated on some harmonious system that will be fair to all and immeasurably better for the travelling public. It is unfair to say that the gentlemen controlling these properties are unenterprising because they have not already changed from steam to electricity. They know well enough that electricity on new and independent lines and on tramways works better and quicker, is cheaper, and more comfortable for the passengers than steam, but they are not satisfied that these smaller units of their great systems can be worked with one system of propulsion, and their larger trunk lines, with heavy freight trains, by another. Whatever, therefore, is done in this direction by these railways, must be done with two distinct things in view, namely, the installation must first be capable of operation with the existing steam system outside the London radius, and secondly, it must be capable of extension to that system, as further improvements make it practicable and economical so to extend the electrification. Let the experts engaged in these modern problems of locomotion once satisfy the railway managers on these two points, and the steam locomotive will disappear, not in a night, but by degrees, first, as we hope will soon be the case on the Inner Circle, then on these cross and joint lines, and finally on the trunk lines. The theatre of these experiments is now clearly defined, and the future extension of operations of this sort will

in a large measure depend upon the outcome of the electrifications in progress of installation.

Another movement working for the relief of the streets, and one which will be almost imperceptible at first is the change of the omnibus and car companies from horse to motors. It will take time to effect these changes as it will to change the large waggons and delivery carts in the same way, but it is a change that all authorities on the subject admit is sure to come, and when it does will have its influence.

In the aggregate the work going forward at the present time is enormous, and as we have seen exceeds in mileage and capital investment the great works which I have mentioned in Paris, New York, and Chicago, which are the only cities that are doing anything at all comparable with that which is being done in London. This is no reflection on the enterprise of the other cities, some of which like Boston and Berlin are doing interesting and important work. As a rule, however, most of the modern towns of the world are fairly well supplied with rapid transit, and in these cities the problem does not present anything like the difficulties and obstacles which have to be overcome when dealing with this question in the greatest of all modern centres of population—London.

DISCUSSION.

The CHAIRMAN said he had lived the greater part of his life in London, and he thought there were few questions of greater importance to Londoners than the increase of locomotive facilities. He had had almost unique opportunities of seeing the marvellous augmentation to the population of inner and greater London. Thirty-seven or thirty-eight years years ago he was elected M.P. for the County of Middlesex, which comprised the whole of the outer area north of the Thames which was outside inner London; and he had seen with his own eyes, decade after decade, the extraordinary development of population in a district which, thirty years ago, was an almost purely rural district. He believed the population he represented when he first went into Parliament was about 200,000; and he was quite confident that it was now considerably over one million. There was the peculiar phenomenon about this great increase of population that, so far as he knew, great aggregations of population had about entirely been caused by an important industry being created in a locality, which attracted large numbers of men and women seeking employment. The peculiarity of the increase of population in the suburban parts of London was that a very considerable portion of the people were divorced from their work; they had to yield to certain irresistible economic forces. There was a process going on in London by which, year after year, more and more houses in the inner circle were being demolished, or converted into places of business and factories. There was, in one sense, a centrifugal movement going on in the centre of London, by which the population were forced more and more into the outer parts of London. But, inasmuch as a large proportion of the people so forced out still had their occupation in London, there was the reverse movement, the centripetal movement, by which every year a large proportion of the outer population of London were forced into London daily in order to pursue their avocations, and obtain their livelihood; and it was that condition which, he thought, presented the great difficulty of locomotion in London. It was clear to all who knew London, that although there might be no difficulty in largely increasing the mechanical means of locomotion in Greater London, yet so soon as one dealt with inner London, it was almost impossible, under existing conditions, largely to increase surface locomotion. London streets were not built in accordance with any great plan; they were the streets of a number of original hamlets or villages which became absorbed in London; and therefore it was almost impossible to develop any system of electric tramways such as other great capitals, built on a different system, had supplied themselves with. He remembered many years ago discussing the question with Sir Edward Henderson, who was, at that time the Chief Commissioner of Police; and that gentleman summed up the situation very clearly in a sentence, when he said:—"The streets of London were intended for a traffic of 500,000 people, and I have to manage five millions." He thought everyone would agree that if it were not for the marvellous tact, patience, and skill shown by the Metropolitan Police in the management of traffic in crowded streets, great difficulty would be found, at certain times of the year, in getting about at all. That being so, it was clear that if an increased demand for locomotion arose, and if it could not be met by an increase of mechanical appliances on the surface of the earth, recourse must be had to underground railways, which must be of such a character as not to interfere with the comfort or stability of the houses already erected in London. The question of greatest interest to the audience was, would electric railways in London be able to meet that particular and ever-increasing want? If it were possible to solve the difficult problem of improved locomotion in London by underground electric railways, he did not hesitate to say that those who achieved the object would confer an enormous benefit upon London generally. Mr. Porter had given evidence in his paper of the possession of a thorough appreciation of the requirements of great cities in respect to improved locomotion.

MR. PHILIP DAWSON thought that everyone present would agree with him in saying that thanks were due

to the author for the excellent way in which he had brought forward a most difficult subject. Mr. Porter had pointed out that whilst a good deal was heard of the work which was going on in such cities as New York, Boston, and Paris, in regard to additional rapid transit facilities, and whilst very often the work which was being carried on in London was condemned, as a matter of fact at the present moment there were greater rapid transit facilities being constructed and completed in London than in any other city in the world. He congratulated the author on the fact that although he was originally an Englishman, he was one of those people who were greatly appreciated in the United States. Personally, he took a peculiar interest in the subject under discussion, as it had been his lot for several years past to investigate the question of the possibility of introducing electric traction on main line railways; and there were some points in that connection with which he joined issue with the author. Mr. Porter had suggested that large power stations might be constructed which would supply energy to a great many railway companies, and that that would facilitate the electrification of railways. He could not agree with him on that point, because on the railway whose requirements he had been studying for the last two years, from 40,000 to 50,000 kilowatts, or, roughly speaking, 75,000 horse-power, would be required for handling their suburban traffic alone. From the result of the examination he had made it was his opinion that once an amount of 20,000 or 30,000 horse-power was reached, no saving could be made in regard to capital expenditure or operating expenses; and naturally, as the author stated, a railway company would prefer to have its own power station rather than purchase power elsewhere, particularly when the fact was considered that railway companies were in a particularly favourable position to produce electricity cheaply and economically. There was one point made by the author with which he thoroughly agreed, and which he wished to emphasise, namely, the absolute necessity of doing away with the third rail. In the investigations which he had made, he reluctantly came to the conclusion, although he had sometimes been called an electrical enthusiast, that if the third rail were a necessity to the electrification of main line railways, electrification could never take place. But fortunately the requirements of railways had brought forth a solution. As the author stated, the single-phase system enabled engineers to use currents at very high pressures, and overhead wires, and would thus dispense with the third rail, which was not only dangerous to the travelling public as well as to the company's officials, but was also a source of greatly increased expenditure in regard to maintenance. That system was to be tried on the Brighton Railway Company on the first section between Victoria and London-bridge, and he trusted that perhaps a year hence the line would be successfully operating, and that he might be able to show those present over it.

Mr. E. L. Walford said that those who travelled on the Great Northern and City Railway must have noticed how superior the ventilation of that railway was compared to either the Central London or the City and South London, and he thought the reason of it was that there was an open-air station at Drayton-park. He wished to ask whether it would be practical for the other tube railways to have an open-air station at the highest point of the tube, and so ventilate the line. It seemed to him a very great pity that in the general electrification of railways which was now proceeding nothing was being done to electrify the East London Railway, which was the most important link of the systems north and south of the Thames. He thought the electrification of that line might easily be managed by the different companies who at present leased it guaranteeing the interest on the capital necessary to electrify it.

Mr. J. F. Loree said that he was unable to add to the details the author had given of what was being done in the States on the rapid transit question, but he could assure the members that they were all troubled with the magnitude of the problems in front of them. As he listened to Mr. Dawson the question ran through his mind whether a decided advantage was not obtained in a community of interests in generating stations by the support they gave each other in emergencies, and by a more economical load line resulting. One of the great difficulties connected with the use of electric power was that facilities always had to be provided for generating the maximum amount of power to be used for only a short period of time. It happened that during the two or three years when he was president of the Baltimore and Ohio Railway—which was the first railway in America to use electric power for traction purposes—in the effort to get a more economical load line large amounts of power were supplied to the local traction lines in Baltimore, and to the manufacturing establishments throughout the city. Certainly if that power-house could have furnished power to other railway companies, and they had a joint interest, it would have been a very much more economical undertaking. It might interest those present to know that when Baltimore was overtaken with a great calamity in February last year, and some 132 acres of buildings, comprising the principal business portion of the city, were burned, the electric lighting stations and power-house of the local traction companies were destroyed, and in the emergency the generating plant of the Baltimore and Ohio Railway had not only to maintain the railway traffic through its tunnel, but to light the town and furnish power for local traction purposes.

Mr. Francis Fox said the question had been asked whether science, engineering, and capital could provide a solution to the traffic problem. On behalf of the engineering profession, he could give a distinct

answer in the affirmative. If the necessary capital and powers were supplied, and they were kept free from the absurd restrictions which were often placed upon them by borough councils and other bodies, he believed the great traffic problem of London could be successfully solved. The question of the increase in the number of passengers aud the number of journeys per head, was a matter of education. When he was last in New York, he had to investigate the number of journeys that were made per head of the population in that and other great cities; he also did the same work in London; and he found that while in New York 500 journeys per annum were made per head of the population, in England it was only something like 1-10th of that figure. It was stated in an old book that, at a certain period of the world's history, knowledge would be increased, and many would run to and fro; and he thought that point had been reached. He believed English people were learning to run to and fro, but he hoped they would not reach the point arrived at in America, where people seemed to be imbued with the idea that they would be much happier anywhere else than where they were. The first object an American seemed to wish to attain was to get into a tramcar and go into the country or to another part of the city, and there jump into another car and come back again. He did not think that conduced to the welfare and stability of a nation; and although Englishmen had many things to learn from their American cousins he hoped that they would not copy the terrible rush and haste that was seen in Chicago and New York. The last speaker had referred to the tunnel at Baltimore. He was very much struck when he visited that city with the excellent arrangement made for carrying the fast trains through the tunnel and letting them go on their journey without even stopping, the electric locomotive running ahead into a siding and allowing the train to pass. He believed the arrangement was called "fly shunting." He quite endorsed Mr. Dawson's remarks with regard to the third rail. It was an absolute impossibility to have a third rail on a ballasted road. A third rail could be used on a overhead railway, where it could be fixed to the floor of the structure, or it could be used in a tube with a comparatively low voltage, but on a ballasted road, where men were continually packing the sleepers, it was a matter of absolute impossibility to use it, and it would prove a grave danger, as was illustrated by the numerous accidents which had taken place in the North, where platelayers with shovels in their hands had had the shovels destroyed by their getting in contact with the current. The sooner the third rail was abolished from a ballasted road the better it would be for the whole of the travelling public. The question of high tension was a very serious one. Anyone who had seen a high tension wire break, and hang dangling down "fizzling," knew it was not a nice thing to see, and it was certainly a disagreeable thing to come in contact with. That was a difficulty which would have somehow or other to be solved. With regard to the increase of the traffic on London underground lines, it was an ill fog that did not do somebody benefit. He thought the recent fogs had educated the public to a very great extent in regard to the enormous benefit of tube railways in more ways than one. The temperature of the tubes was practically the same summer and winter; the streets of London might be blackened with a dense fog, while down in a tube it was perfectly clear. It was exactly the same in the Mersey tunnel; while there was a dense fog on the Mersey it was perfectly clear below. The consequence was that traffic could proceed on the tubes without any difficulty; and fogs were therefore educating people into the beneficial use of underground railways, and, to that extent, would clear the streets of the congested traffic from which London at present suffered so much.

Mr. T. C. Jenkin (Manager of the City and South London Railway) apologised for the absence of the chairman of his company, who regretted his inability to attend the meeting. The City and South London was the pioneer electric railway of London; and the late Mr. Greathead and the Chairman of the City and South London Company were the pioneers of electric traction in London. It was a great compliment to his railway that most of the subsequent lines which had been built and were now in operation were due to the success of his own undertaking. No difficulty was experienced with the third rail on their railway. The railway had been in operation for fifteen years, and no accident of any kind had happened; while there was no danger whatever if the men happened to step on the rail. With regard to the question of atmosphere and ventilation, a most eminent engineer inspected their line, and reported that the ventilation was perfect, in fact he referred to it as the Riviera.

Colonel Allan Cunningham said the question of ventilation very closely touched the question of the personal comfort of the passengers. No doubt the ventilation of the Metropolitan Railway would be good as soon as it was electrified, but it was different in the case of the small tubes. The "twopenny tube" was so small that its ventilation left a great deal to be desired, and he would like to ask the author what was the condition of the atmosphere in the 32 miles of tunnels in Chicago.

Mr. Porter stated that the tunnels in Chicago were only used for freight purposes, and the ventilation was not at all bad. There were only a few people down in the tunnel, which had an opening right on to the Lake front.

Colonel Allan Cunningham doubted whether such a tunnel would be useful for passenger traffic with only one such opening. As probably one of the

oldest persons present, he had seen a vast change come over the conditions of London traffic. Fifty years ago there were very few omnibuses; the shortest journey on an omnibus cost 6d., and the population was then only three millions. Every increase in the facility of travelling had been a great help at the time—too much at the time perhaps—but the increased facilities had attracted more customers to the lines, and more residents to the places which the lines served. Those conditions, and the natural increase of population, had invariably after a time overtaken the increased facilities, so that five or ten years afterwards the congestion on various lines had been just as great as ever. He apprehended that though the new railways proposed would be for a time a very great convenience they would follow the rule of all previous history, and in the course of some twenty years the congestion of traffic would be as bad as ever. The very great convenience of pouring crowds of people into a large city at their business hours was a thing to be sought after, but it was attended with one serious inconvenience. The time did not seem to be far distant when the streets would not be sufficient for the great number of foot passengers in them. That happened with serious results on the occasion of any great public spectacle. Within the last fifty years the crowds at public spectacles had increased to enormous proportions. The suburban railways offered such facilities for throwing enormous crowds into the city to see any big public spectacle, that the crowds were now getting more and more dangerous, and that was a difficulty which would have to be met somehow.

Mr. NORMAN MACDONALD said that the overhead wire on the Brighton railway, which was to carry 6,000 volts, to which Mr. Francis Fox had referred, would practically be a continuous girder or bridge, and therefore any chance of a catastrophe occurring through it being broken by ice or storms did not apply, because it would be powerful enough to carry many tons weight. The author had referred several times to the Royal Commission on London Traffic. He was inclined to think the real fun in connection with the transportation problem would begin after the Commission had reported. It was possible the Royal Commission might report in favour of shallow tunnels, but it was well to consider whether it would be worth while to carry out such a scheme. In the first place, he believed the public in a city like London would prefer to keep on the surface if they had facilities for travelling distances under a mile, and would not mind going down a tube provided they could get a fast conveyance from one fairly distant point to another fairly distant point. He thought London should not be placed in the unfortunate position in which New York found itself in 1901, when many of the main thoroughfares were in a state of perfect chaos owing to the building of the shallow tunnels. If the Traffic Commission reported in favour of any extension of street surface trams, he believed the fun would again begin, because that would be the greatest possible mistake in London. Having lost a good deal of money in a street locomotion undertaking, he advised those people who held shares in omnibus companies which were enterprising enough to go in for motor omnibuses not to part with their shares. He did not think the public would stand the breaking up of their streets for the purpose of increased surface trams, because not only would rapid transit on the surface be more difficult, but the trams would congest themselves as well as the streets. What London would have very soon, and what it would find much better than tramways, was a proper service of motor omnibuses. He was largely responsible for the first public service of motor omnibuses in Great Britain, viz., in Edinburgh, where at one time as many as twenty-nine public service omnibuses were running. Unfortunately money was lost in the undertaking, firstly, because a good manager could not be obtained, and, secondly, because the right sort of vehicle was not chosen. It would not stand the traffic and the work, and would only carry seven or eight passengers besides the driver. The right vehicle had now been constructed, and in a town that was decently paved, like London, the people would stay on the surface if they were given a good method of transportation. He would like to ask the author whether he said that the two circular railways in Berlin and Paris were built for military purposes.

Mr. PORTER replied that he thought the Berlin railway was.

The CHAIRMAN proposed a hearty vote of thanks to the author for his admirable paper. He had expressed the opinion in introducing Mr. Porter to the meeting that they might expect an important and practical paper, and he would say now that the result more than confirmed what he had said.

The resolution was then put and carried unanimously.

THE FOREIGN FRUIT INDUSTRY.

"Considering," writes Mr. John Plummer in the paper on Australian Fruit Produce in the last number of the *Journal*, "that in Australia the seasons are reversed, and that all the leading British and American summer fruits, such as cherries and strawberries, are most plentiful from November to February, there should be a large oversea market for them." No doubt there will be by-and-bye, but meantime the imports of fruit from Australasia are restricted mainly to apples, it being difficult to bring over pears in good condition, and impossible to do so with the softer fruits. It is a little surprising that our

fruit imports have shown very little expansion in recent years, at any rate until the last year or two. Take the first and last year of the decade 1892-1901. The value of the imports of the principal fruits was in round figures as follows:—

	1892.		1901.
	£.		£.
Apples....	1,354,000	..	1,183,000
Pears	297,000	..	296,000
Plums	200,000	..	244,000
Cherries ..	135,000	..	214,000
Grapes....	394,000	..	695,000
Total ..	2,380,000	..	2,632,000

The imports of apples and pears were of smaller value in 1901 than in 1892, and the only very marked increase was in grapes.

If we take the years since 1901 the increase is greater. The following figures give the comparison for the ten months ended October 31 of the years named:—

	1902.		1903.		1904.
	£.		£.		£.
Apples ..	1,156,987	..	1,837,199	..	1,584,168
Pears....	411,518	..	295,192	..	455,905
Plums ..	513,339	..	621,535	..	535,987
Cherries	216,421	..	167,142	..	319,969
Grapes ..	587,949	..	589,043	..	639,485
Total..	2,886,214	..	3,510,111	..	3,535,514

The value of the whole of the fruits imported for the ten months ended October 31 of the three years 1902-4 was as follows:—1902, £7,198,049; 1903, £8,006,236; 1904, £8,008,165. Strawberries show a decrease from £58,080 to £49,536; almonds from £377,261 to £363,879; other nuts used as fruits from £426,172 to £378,556; and oranges, strange to say, from £1,783,219 to £1,629,000. The principal increases were in apples, from £1,156,987 to £1,584,168, largely due to increasing imports from the Dominion, and bananas, which imported to the value of £905,218 in the first ten months of 1902, were valued for the corresponding period of 1904 at £1,170,483, an expansion due to some extent to the increasing imports from the West Indies. The home area under orchards grows but not very rapidly, and is mainly confined to England, for it is almost at a standstill in Wales, and only increases slowly in Scotland. It is much the same with the home area under small fruit, though Scotland has a much larger acreage of small fruit than of orchards.

A brave attempt is being made to create a large fruit trade between the United Kingdom and the West Indies, and few ventures would seem to be more promising. The islands are within comparatively easy reach of England; cold storage has made it possible to preserve the most delicate fruits in good condition; fast steamers are at the disposal of shippers; the soil and climate are unsurpassed for tropical fruit production; there can be no solid prosperity in any of the islands whilst the present dependence upon the sugar industry remains undiminished, yet the fruit exports increase very slowly if Jamaica is excepted. And even in Jamaica the industry does not rest on a solid basis. A large fruit trade between Jamaica and the United States has been created during the last thirty-five years, greatly to the advantage of the island, and from time to time attempts have been made to create a similar trade with the Mother Country. But until quick and suitable steam transport could be secured this was impossible, and no such steamship service was procurable without an Imperial subvention not to be got. This initial obstacle was overcome three or four years ago, when the present Government agreed to pay a heavy subvention to Elder, Dempster and Co. for the required service. Since then the fruit exports, especially of bananas and oranges, show a large increase, but much remains to be done before the trade can be said to be in a healthy condition. There is a market on this side for all the fruit of good quality that Jamaica can supply, but quality is essential, and that is a truth that is only imperfectly grasped in Jamaica. The planters do not concern themselves with the taste of the market, they neglect grading, and are careless as to the condition in which the fruit reaches the consumer. For example, they grow a large, coarse banana, known as the *Gros Michel*, for the American market. It seems to suit the American taste, but English buyers prefer the smaller banana of the Canaries, *Musa Cavendishii*, and these fetch twice the price of the coarser kind. Nor is it only that the sort of banana sent is the wrong sort for the English market. No attention is paid to grading or to packing. Colour and size, too, are disregarded. The bananas that come from the Canaries are carefully graded and packed. They are wrapped in wadding and paper, and put into crates, and covered with banana tops or other soft stuff. When they reach port the same care is taken to get them to the fruit brokers quickly and without injury. The Jamaica bananas have no such care. They are lumped down in the steamers and when they get to Bristol are sent to London loose in trucks. The consequence is that the brokers can always get twice as much for bananas from the Canaries as from Jamaica, though there is no good reason why Jamaica bananas are not of equal quality and condition to those from the Canaries. It is the same with oranges. Jamaica might do an immense trade with England in oranges. Jamaica oranges can be put upon the market in excellent condition in October, when they have nothing to fear from competition. The Spanish and Mediterranean oranges are not eatable until after Christmas, so the West Indian variety has the market to itself for three months or more, and during that period large numbers are sold. But a much larger trade would be done, and better prices got, if more attention was paid to grading and packing. And so with mangoes. The home of the mango may be said to be India, and some years ago one of the native princes made a

serious attempt to create a large export trade in them with England but without success. They seldom arrived in good condition. But in Jamaica some of the best known Indian descriptions flourish, and all that is wanted to land them in excellent condition here is careful grading and packing, which they seldom get. And what is true of Jamaica is equally true of other West Indian islands. The pineapple, for example, flourishes everywhere, and some of the pines, the Montserrat for instance, are of very delicate flavour. But this pine is unsightly and not suitable for the English market. The best for this trade is the smooth Cayenne, grown so largely in the Azores, and now beginning to be grown in the West Indies. It has, too, to be remembered that the pine is grown for ornament as well as quality. The crown of the pine is the glory of it, and it is found that the "wind and weather" to which it is subject in the West Indies injures its appearance, a drawback that might easily be overcome by the erection of some sort of inexpensive sheltering. But nothing is done. Just as the English farmer thinks all that is necessary to make a paying orchard is to plant a certain number of apple trees without much regard to adaptation of kind to soil, and to pick them when ripe and send them anyhow to market, so the West Indian grower pays little attention to quality. But it is quality, as Mr. Monro, of King-street, Covent-garden, is never tired of insisting—and he is one of the biggest fruit-brokers in the kingdom—that is the one thing indispensable in fruits that are to secure any hold on public consumption.

The fruit exports of Cape Colony are growing slowly. They consist almost entirely of apricots, peaches, plums, and grapes, more especially grapes, and they reach this market just at the best time for sale, when English and Spanish supplies are getting scarce. Much more attention is given than in the West Indies to grading and packing, and the colony owes much to the late Mr. Rhodes for showing on his model farms how the fruit industry ought to be conducted. He got one of the best men for the work, Mr. Pickstone, to start the business, with skilled men, with the result that grading and packing are what they should be, and the fruit comes over in splendid condition. This cannot be said of all the fruit exports from the Cape, but the Rhodes example has told, and is telling.

It is largely a question of labour. The great expansion and success of the Californian fruit trade is chiefly due to the skill of the Chinese labourers, deftest of packers. And so in the Canaries, where the Spaniard, whom we are apt to think of as lazy and careless, shows the greatest care in grading and packing. For example, every tomato, of which millions are sent to England every year from the Canary Islands, is wrapped in paper and most carefully packed. The utmost attention is given to details of management, and the result is seen in the high prices commanded in the English market by the fruit products of the islands. Young farmers with a little capital might find it to their advantage to take it to Jamaica, Barbadoes, or Trinidad, and put it into fruit farms. But they should first master the business of fruit growing and export as worked in the Canaries and California, and they must remember that close and constant personal supervision is indispensable to success. The labour difficulty is not insuperable given tact and brains on the part of the grower.

PRECIOUS STONES IN CEYLON.

The precious stones found in Ceylon are rubies (*i.e.*, red sapphires), blue, yellow, white, pink, and occasionally green sapphires, and asterias (star stones), the latter being, when of fine quality and ruby-red colour, the most expensive fancy stones known, according to the American Consul at Colombo. The other gems are alexandrites, beryls, chrysoberyls, cats'-eyes, amethysts, garnets, moonstones, and zircons, also a red stone which the natives call "killinge." Gem mining is now purely a native industry, the work is done in a primitive manner, and frequently on the communal system. No great skill is exercised. A prospector selects a likely locality and pays the Government for a permit to mine for gems. Men then go to work digging a pit, generally from ten to fifty feet deep, sometimes deeper, until they reach the gravel in which the gems are found. This is carefully washed and sifted until every particle of value is obtained. Sometimes the harvest is rich, but oftener it is very poor, consequently the production of gems suitable for jewelling is not large, and the local demand for such stones is so fully equal to the supply that, except in cases where the specimens are really promising, rough stones are not sent abroad, but are cut and polished by the local lapidaries and readily sold by local jewellers, mostly to travellers. The pearl fisheries of Ceylon have been known and celebrated from time immemorial, and the output in 1903-4 was very profitable. Seasons occur at irregular intervals, owing to frequent disappearances of the oysters from mysterious natural causes, before they reach their proper age of production—four to six years. When they mature a fishery is advertised, and forthwith a vast throng of speculators and sight-seers from all parts of the world, but mostly from India, flocks to the scene of operations near Aripo, something over 120 miles north of Colombo. More than 200 boats manned by natives, and each possessing a complement of divers, come from far and near, and during the calm, smooth water months of March and April the fishing operations progress daily, the number of oysters obtained averaging about 1,000,000 per diem. The principal buyers are from the Coromandel and Malabar coasts of India, and that country receives a large share of the pearls. The next largest portion falls to the local speculators, who send a few to Europe, but find in the Ceylon market a ready sale and better price for those that are retained.

WOODEN COTTAGES AND INSURANCE.

In discussing rural housing in the last number of the *Journal*, the question of insurance was mentioned, and reference was made to the Norwich Union. Since then the writer of the article has had the advantage of discussing the point raised with the general manager of that great insurance society, who confirms what was said in the *Journal*, namely, that cottages of other than brick or stone are insurable to the amount of the rent charge. There is no kind of new cottage that is not insurable. It is simply a question of rate, and the rate is not prohibitive. Take the most inflammable, all wood, thatched, and in a row. The charge would be 7s. 6d. per cent. But thatch is no longer used for covering, and for a wooden cottage tiled, the rate is 5s. per cent., provided the local authority has approved of the heating arrangements, and there is proper separation of the cottages, one from the other, or there is a brick wall between two, carried up above the roof. What the insurance offices call "moral" risk does not weigh where cottages are put up by landowners although it might do so in the case of a speculative builder unable to sell or let his cottages. Anyway, the insurance difficulty, as applied to the erection of cottages by landowners or local authorities, disappears when examined. The owner of the most inflammable cottage, valued at £150, can guard against loss by an insurance charge of 11s. 3d. per annum, and in the case of the majority of wooden cottages of that value the annual charge would not exceed 7s. 6d.

OBITUARY.

LIONEL VAN OVEN.—Mr. Van Oven, who died on the 8th inst. at his residence at 6, York-terrace, Regent's-park, aged 75, had been a member of the Society of Arts since 1867, and he was an occasional contributor to the *Journal*. In 1870 he and Mr. Assur Moses were invited by the late Baroness Meyer de Rothschild to assist in founding the Association for the Oral Instruction of the Deaf and Dumb. He became greatly interested, and was an active worker in the cause, and on the death of the late Sir George Dasent became chairman of the executive committee of the institution. He continued to give unremitting attention to the work till 1898, when he resigned owing to ill-health. In 1887 he was appointed by Queen Victoria, on the recommendation of the late Earl Granville, as a member of the Royal Commission on the Blind, the Deaf, and Dumb, &c., under the chairmanship of Lord Egerton of Tatton, and took an active part in the inspection of the various institutions, and in the inquiry generally, both at home and abroad. In connection with the Royal Commission, two Acts of Parliament were passed, bringing both the blind and the deaf and dumb within the scope of the Education Acts. Mr. Van Oven was also president of the Union of Teachers of the Deaf on the Pure Oral System.

GENERAL NOTES.

THE UGANDA RAILWAY REPORT.—The report on the construction and working of the Mombasa-Victoria (Uganda) Railway and Steamboat Service on Lake Victoria just issued ("Africa," No. 16, 1904), is not, on the whole, an unsatisfactory record of progress necessarily slow. In the early part of the year under review the traffic working suffered, owing to the line being still incomplete in many respects, while from April to September heavy rains caused much delay. The financial forecast estimated the deficit of the year at £65,000, actually it was only £60,100. The original estimates for the current year's (1904-5) working showed a loss of £45,000, but the Manager's revised estimates, prepared in November, show a deficit of £10,000 only, and it is expected that a further reduction will take place in 1905-6. With reference to the deficit, it is pointed out that all Protectorate stores are carried at actual cost price, and that "without the facilities afforded by the railway the cost to the State of holding Uganda and the head waters of the Nile would have reached a sum twenty times greater than the apparent deficit. The cost of carriage of the amount of Government stores now used in the Uganda Protectorate by the old method of porters, would not only be sufficient to obliterate the deficit, but to pay a small percentage on the capital cost of the railway as well." It is to be noted that there was a constant increase in the downward traffic as from the Lake to the coast—35 per cent. of the total tonnage carried, as against 21⅜ per cent. for 1902—the upward or import traffic remaining almost stationary. Much of the increase downwards is due to the traffic brought in by the Lake steamers, which has the great advantage, so far as the railway is concerned, of passing over its whole length. A second steamer was put on the lake in January last, and a third is urgently required, and is about to be supplied. The working of the two steamers for the year showed a surplus on the cost of operating.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

FEBRUARY 1.—"The Navigation of the Nile." By SIR WILLIAM H. PREECE, K.C.B., F.R.S. SIR ROBERT HANBURY BROWN, K.C.M.G., will preside.

FEBRUARY 8.—"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY. GEORGE DAVISON will preside.

FEBRUARY 15.—"The Decline of the Country Town." By ARTHUR HENRY ANDERSON.

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN, F.S.A. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

JANUARY 31, 8 p.m.—"Calligraphy and Illumination." Two Papers. By EDWARD JOHNSTON and GRAILY HEWITT. LEWIS FOREMAN DAY, Vice-President of the Society, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic, and Fountain Pens." Three Lectures.

LECTURE II.—JANUARY 30.—*Stylographic Pens.*—Rudimentary forms—Early patents—Rigid points, needle points—Various writing or marking pens—Modern Stylographic pens, Nota Bene, Cygnet, and others—Gold pens, description of manufacture.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements — Self-filling reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. James P. Maginnis, "Reservoir, Stylographic, and Fountain Pens." (Lecture II.)

Farmers' Club, Whitehall-rooms, Whitehall-place, S.W., 4 p.m. Mr. Robert A. Yerburgh, "Agricultural Co-operation."

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on the papers read by Mr. Stenning and Mr. Menzies.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. E. R. Dibden, "The Magic Carpet."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. B. Kidd, "Social Evolution among Social Insects."

Faraday Society, 92, Victoria-street, S.W., 8 p.m. 1. Mr. John G. A. Rhodin, "Mass Analyses of Muntz's metal by Electrolysis, and some Notes on the Electrolytic Properties of this Alloy." 2. Prof. R. Beckett Denison, "The Equilibrium between Sodium and Magnesium Sulphates." 3. Mr. E. Kilburn Scott, "Refractory Materials."

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. S. S. Thorburn, "The Place of India Under Protection."

TUESDAY, JAN. 31...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Edward Johnston and Mr. Graily Hewitt, "Calligraphy and Illumination." Two Papers.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Structure and Life of Animals." (Lecture III.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. L. E. Clark, "Floating Docks."

WEDNESDAY, FEB. 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir William H. Preece, "The Navigation of the Nile."

Geological, Burlington-house, W., 8 p.m.

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Presidential Address by Mr. J. A. Crowthier, "The Bye-Laws."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

THURSDAY, FEB. 2..Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. J. Futcher, "New Chinese Plants from the neighbourhood of Hong Kong." 2. Dr. H. J. Hausen, "European Marine Species of Cirolaninæ (Isopoda)."

Chemical, Burlington-house, W 8 p.m. Messrs. M. O. Forster and H. E. Fierz, "Studies in the camphane series. (Part XVI.) Camphorylcarbimide and isomeric camphorylcarbamides."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Henry Tiedeman, "The Balkans."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Schlich, "Forestry in the British Empire." (Lecture I.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. A. R. Tattersall, "The Mechanics of Flour Milling."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, FEB. 3...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Prof. T. Clifford Allbutt, "Blood Pressure in Man."

Geologists' Association, University College, W.C., 7½ p.m. Annual General Meeting. Address by the President, "Modern Methods in the Study of Fossils."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, FEB. 4...Royal Institution, Albemarle-street, W., 3 p.m. Sir Alexander Mackenzie, "The Bohemian School of Music." (Lecture I.)

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FRIDAY, FEBRUARY 3, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 6, 8 p.m. (Cantor Lecture.) JAMES P. MAGINNIS, "Reservoir, Stylographic, and Fountain Pens." Lecture III.

WEDNESDAY, FEBRUARY 8, 8 p.m. (Ordinary Meeting.) R. CHILD BAYLEY, "Time Development in Photography, and Modern Mechanical Methods of Carrying it out."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. JAMES P. MAGINNIS delivered on Monday evening, 30th January, the second lecture of his course on "Reservoir, Stylographic, and Fountain Pens."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday evening, January 31st; LEWIS FOREMAN DAY, F.S.A., in the chair. Two papers were read by EDWARD JOHNSTON and GRAILY HEWITT on "Calligraphy and Illumination."

The papers and report of the discussion will be published in a future number of the *Journal.*

VIVÂ VOCE EXAMINATIONS IN MODERN LANGUAGES.

The following is a list of the *Vivâ Voce* Examinations which have been held since the last announcement in the *Journal* for June 24, 1904:—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French :—					
L.C.C. Evening School, Offord-road, Barnsbury	June 27, 1904.	21	2	15	7
L.C.C. Evening School, Plough-road, Clapham Junction	June 28, 1904.	17	1	11	5
L.C.C. Evening School, Queen's-road, Dalston	June 29, 1904.	13	5	6	2
L.C.C. Evening School, Offord-road, Barnsbury	June 30, 1904.	24	5	16	3
L.C.C. Evening School, Sussex-road, Brixton	July 1, 1904.	27	5	16	6
Municipal School of Science, Brighton......	July 11, 1904.	14	1	10	3
Merchant Venturers' College, Bristol.........	July 12 & 13, 1904.	68	4	33	31
German :—					
L.C.C. Evening School, Queen's-road, Dalston	June 20, 1904.	16	5	8	3
L.C.C. Evening School, Offord-road, Barnsbury	June 23, 1904.	17	2	6	9
Merchant Venturers' College, Bristol.........	July 14, 1904.	35	3	20	12
Spanish :—					
L.C.C. Evening School Queen's-road, Dalston	July 14, 1904.	14	2	7	
		269	35	148	86

The Examiners were Mr. E. L. Naftel for French, Professor H. G. Atkins, M.A., for German, and Professor Ramirez for Spanish.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal,* cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, January 19th; Sir WILLIAM LEE-WARNER, K.C.S.I., in the chair.

The CHAIRMAN said the presence of such a large audience was a sufficient indication that they were all acquainted with the author and knew what to expect from him. He considered the Section was extremely fortunate in having got Mr. Freshfield to comply with its request that he would give a paper that afternoon on the subject of Sikkim. As one of the founders of the Alpine Club he was known to many; to more as an expert in geographical knowledge, having attained the highest honours which it was possible to obtain from the Geographical Society in this country; and to a larger circle he was still better known by the charming books he had written on the Caucasus, Kangchenjunga, and other subjects.

The paper read was—

THE GATES OF TIBET.

By DOUGLAS W. FRESHFIELD.

When I first undertook to address an audience belonging to this Society, I did not realise that the invitation came from a specifically Indian Section. Had I done so I might have hesitated to accept it. For I have learnt by frequent experiences during a long geographical career that Anglo-Indians, those who have spent a large part of their lives, a quarter of a century or more, in a tropical climate, are extremely critical as to any remarks the fair-weather tourist, or "globe trotter," as they call him, may venture with reference to the scene of their labours. The attitude is, I admit, natural, in many cases justifiable, and I am not at all disposed to complain of it. But when I suggested this consideration to Sir William Lee-Warner he kindly replied that I might count on indulgence in the Society of Arts because I was regarded as an artistic traveller. Now an artist, I believe, is one who embellishes facts. There may be, even on the Tibetan frontier, travellers answering to this description. The Himalaya, like the Alps, may have their Tartarin. But I have no ambition, even had I the power, to rival such feats. As Wordsworth wrote, "The moving accident is not my trade." I am no artist with pen or pencil.

I must look in another direction for an excuse for my audacity in facing you this afternoon. I reflect that the country I am invited to talk about, the frontier land of Tibet, is, after all, not India at all, and linked only to India by the newest of political bonds: that in its natural characteristics and its population it is a wholly distinct region, which comes within the scope of but few Anglo-Indians, and which even a high ex-official may know very little about.

The first and the most abiding impression made on the newcomer from India on his arrival at Darjeeling is that he has entered another country, almost another quarter of the globe; he recognises that he has changed not only sky and landscape, but architecture, people, and religion. Broad-framed, wide-faced, thickly-clad, laughing Tartars, a trifle "smouchy," to adopt Charles Lamb's epithet, take the place of the slender, thinly-clad, melancholy Bengalees; Buddhist temples and chortens and prayer-flags have supplanted the village shrines. Instead of vast alluvial plains he finds himself perched on and surrounded by ridges and slopes on which there is hardly level enough to build a house. And as to scenery; I have already added one to the too numerous descriptions of the indescribable splendours of the view from Darjeeling, when, in the sunset glow, Kangchenjunga raises its majestic brow, like a lone beacon-light from another world, above the hundred folds of the foothills and the stark crests of the lesser snows. You need not fear I shall repeat the vain attempt to-day. I propose to do better; to illustrate the scenery of Sikkim by showing you a series of photographic views mostly taken by my companion, Signor Vittorio Sella.

I must now ask your attention for a brief description of the geography of Sikkim, of the district that, owing chiefly to political accident, is the main southern gate of Tibet. The facts I shall lay before you have little or no claim to be novel, but since they have been somewhat obscured lately in the crooked vision of partisans, it may be no waste of time to re-state them. When any question comes within the sphere of practical politics, it comes also within the sphere of party prejudices. It is not I think artists, but politicians who are most prone to disregard or distort facts which do not appear to fit in with their pre-

possessions. Those who disapprove of the recent penetration (it might be a stretch of words to call it a pacific penetration) of Tibet, have naturally felt inclined to believe the very worst as to the inaccessibility and the inhospitality of that country, the fanaticism and poverty of its inhabitants, and the consequent difficulty of entering into trade relations with them. Those who, rightly or wrongly, demur to every action that may result in extending British influence and British responsibility, those also who distrust an energetic Viceroy, were naturally prepossessed against the recent expedition. In the imagination of some of these critics Tibet looms large as a sort of Caliban's Island "desert, uninhabitable, almost inacessible." Now, "the use of travelling," as Dr. Johnson says, "is to regulate imagination by reality, and instead of thinking how things may be to see them as they are." I am not concerned here to-day to dispute a political opinion. But I protest against the attempts that have been made in some quarters to justify it by statements which are either not in accordance with the facts, or represent an imperfect apprehension of them. Thus it has been alleged that Tibet is remote and inaccessible—that it is practically a frostbound desert, untraversable by an army, and never traversed by one—that its inhabitants are as fierce and fanatical as Afghans, and ought to be approached with the same precaution—that the region is beyond the political influence of Russia, has not lately been the scene of Russian intrigues, and could never become a path for Russian aggression. These are, I think, fair specimens of the statements that were put before the public during the early stages of the recent expedition.

Let us briefly examine some of these statements. The present frontier of Tibet, the point from which in 1888 the Tibetans invaded British territory, is about 350 miles from Calcutta, nearer that is by some 200 miles to the seat of Government than the Russian post at Penjdeh is to Peshawar. From the Tibetan frontier Lhasa is (according to the Sikkim Roadbook) about 250 miles by a route which presents no serious physical obstacles to commerce during many months of the year.

The possibility of moving an army across the Eastern Himalaya into India has been proved. In 1792 the Chinese sent an army of 60,000 men into Tibet, and marched down to within 15 miles of Katmandu, the capital of Nepal, where they fought a battle which resulted in the submission of the Nepalese, thus proving the penetrability of the Eastern Himalaya to a large force. Katmandu, of course, is short of the plains of India, but it is as much across the Himalaya as Domo d'Ossola is across the Alps. What the Chinese did once they might easily do again should China ever become a vassal State of Russia. This fact disposes of what a German writer calls Sven Hedin's "exceedingly warm and passionate argument against the British advance on Lhasa."

And as to the military aspect of the Tibetan frontier Major O'Connor reported in 1903, "beyond Khamba Jong the country offers absolutely no difficulty in transporting an army in any direction, as all the tops of the hills and passes leading into Tibet are flat."

Next as to Tibet being a desert. This is a generalisation that has perhaps been formed from bird's-eye views of the uplifted region on the Sikkim frontier, coupled with the narratives of the travellers, Sven Hedin and Littledale, who have crossed the deserts of northern Tibet in their anxiety to escape notice while looking for a backdoor to Lhasa. On first view, it is true, the traveller who has found his way through the mazes of the foot-hills and up the gorges of Sikkim to the top of the long staircase that leads from the plains of India to Tibet is struck by the apparent barrenness of his surroundings. He sees extensive, almost level plains, treeless, and clad only in parts with sparse brown herbage, girt and divided by low ridges. Icy peaks fringe the horizon. In the absence of definite valleys, sluggish streams meander aimlessly across the wide landscape between tawny slopes and beds of skyblue gentians. It is an open country. The only signs of life are the summer stations of the herdsmen, or rare villages overlooked by the high white walls and flagcapt parapets of monastic fortresses. But this is only the rim or rind of Tibet, and even in this rind there are soft spots. Thus Major O'Connor writes (July 18th, 1903):—"Major Bretherton made this morning a reconnaissance towards the southwest, and found a rich and fertile valley some three to four miles from Khamba Jong, where grazing is abundant, and where barley crops are raised and cattle are reared."

A few marches more and the traveller reaches the cultivated region leading to the valley of the Brahmaputra, to which the above description equally applies, as appears from an official report. I may further refer to the description in Mr. Candler's recently-published volume of an "Arcadia in Tibet."

I understand that the valley of the Brahmaputra from Lhasa westwards has been found by the recent Mission to be for a long distance well inhabited and cultivated. The valley of the Brahmaputra is the real Tibet. Generalisations framed from visits to the southern frontier are like descriptions of England founded on glimpses of the Scotch Borders.

The Tibetans are very far from resembling the fanatical Afghans. They are not a warlike people and have never proved themselves formidable. "They are a pastoral people and a trading people, and their religion is a tolerant one," writes Hooker's companion Dr. Campbell. "Until 1783" (until, that is, China had asserted her supremacy), he adds, "the Tibetans were friendly to trade with us."

It would be superfluous, I believe, after what is known to have occurred after the visits of the Lamas to Livadia and St. Petersburg and the flight of the Dalai Lama with his Russian adviser into the Czar's dominions, to deny that Russia has had relations with Tibet. Neither the Russian Government nor the Russian Press has attempted to conceal a fact they know to be publicly recognised not only in England but also in Germany, as is shown in an excellent little volume compiled by Dr. Wegener, which I may have occasion further to quote.

Having, I hope, cleared the ground of these misapprehensions, I will proceed to a more detailed description of Sikkim as the Gate of Tibet. The political state of Sikkim, together with the districts of Darjeeling and Kalimpong (the latter once part of Bhutan), formally annexed to India, coincides at present with the basin of the Tista. From the Himalayan watershed (164,000 feet) to the plains that river runs for about 100 miles in a direct line (more, of course, following its meanders) through a rapidly deepening trench. It is fed by numerous tributaries flowing out of side glens which run up to the vast glaciers of Kangchenjunga on the west and to the lesser snows on the east. At first its trench is broad, but opposite Kangchenjunga (at 8,000 feet) it suddenly drops and becomes a precipitous gorge, which, until the British had mended the track (which was before my visit in 1899), was often impassable for months even for coolies, and was never passable for beasts of burden. Lower down, the Tista runs in a deep valley through soft, billowy foothills, whose slopes are apt to slip away in the rains. This is the track by which I rode up to the back of Kangchenjunga, and this was the track by which we moved troops to Khamba Jong at the commencement of the late frontier troubles. The difficulties are similar to those of many a mule track up an Italian Alpine valley; that is nothing for travellers, but considerable for the impedimenta of an armed force. This route, till a few years ago, having been impracticable for any beast of burden, has never been the trade route to Tibet. That passed up the valley of the next stream parallel to the Tista on the east, the Ammo Chu. Owing to the lower reach of its valley lying in Bhutan, the middle course of the Ammo Chu was reached by crossing a pass either from Bhutan on the east or the Tista Valley on the west.

The passes from the West, about 14,000 feet high (of which the Jelep La, the Yak La, and the Cho La are the best known), are passes of the character of the mule-paths round Mont Blanc. A lady who has been to the Jelep La tells me "it would be a capital place for a picnic for a boys' school" such as go on holiday excursions in the Alps. But what is fun for boys or summer tourists may, of course, be a very different matter for an army, particularly an Indian army with its crowd of followers. Once in the Ammo Chu Valley, there is little further difficulty in climbing to the broad watershed at its head, and descending over the bleak uplands to Gyangtze. This is the commercial travellers' track to Lhasa, and the late expedition reports that there is no serious difficulty for an unopposed force or caravan at any spot on the road.

Have any of my audience been up the Adige from the South?

The traveller going up the Tista to the watershed may compare his first stage to the hills about Trent, his second to the gorges about Botzen, and the third to the open region above Brixen—towards the Pusterthal. The parallel is by no means perfect, but it may serve for want of a better.

The main point to realise is that Tibetan scenery begins, and Sikkim scenery ends many miles south of the watershed, and at a height of 8,000 to 10,000 feet. Below are V-shaped valleys, gorges, steep cliffs, dense tropical forests, a region formerly accessible only on foot; above are shallow troughs and bare rolling hills, "like Wiltshire Downs" (I borrow the expression from Major O'Connor). The one is a country modelled by water, the other a country modelled by ice. The destructive agent has dug deep furrows, the conservative

THE ROADS FROM SIKHIM INTO TIBET.

Scale of Miles

20 5 0 10 20 30

Nat. Scale 1: 1.500.000 or 23.67 miles • 1 inch.

This map has been kindly lent by the Royal Geographical Society.

agent has preserved the primeval smoothness of a land recently emerged from an ice age. Some of Prof. Garwood's photographs of Spitzbergen remind me, in the surface outlines, of the country behind Kangchenjunga.

This configuration of the earth's surface has had naturally great influence on its population, and consequently on political boundaries. In Sikkim in the old days, communications were strangely difficult; the hillsides slipping down in blocks under the perpetual rains, the torrents with their rope-bridges, could only be affronted by sturdy pedestrians. But above the timberline yaks, and even light carts in many places, travel easily. The Tibetans consequently used and occupied the upper pasture region south of the watershed, just as the Germans seized the heads of the valleys south of Monte Rosa. Their herds roamed over Lhonak and the sources of the Tista. They paid no respect to the opinion of geographers that a watershed is a proper political boundary. They practically extended Tibet to the point at which it became too hot for their yaks. Hooker was told he had reached "Cheen," at the Zemu bridge, a mile or two above Lachen.

Sikkim was a decaying State. Its natural fate was to be eaten up by its neighbours Nepal and Tibet. We stepped in and saved it; but in the usual happy-go-lucky way of our statesmen, for some time, took little pains to ascertain its actual boundaries. When I went out to India five years ago the official Indian maps differed between themselves as to the frontier.

It was not till after the war of 1888 that we perambulated the northern boundary and set up certain pillars which the Tibetans promptly disregarded and destroyed. They subsequently proceeded to build a wall across the Upper Tista and forbade access to its passes. These Tibetan aggressions were at first overlooked. We did, however, turn out the monks who had established themselves in a monastery at Chung Chang, at the junction of the two sources of the Tista, the Lachen and Lachung valleys. But till 1902, we took no steps to reclaim for Sikkim the pastures up to the watershed, that is the region of Lhonak, uninhabited, but yearly visited by the Tibetan herds.

In the next valley, that of the Ammo Chu, the Tibetans had fixed themselves more firmly. At Phari, at the very head of the dale, was an old Tibetan frontier fortress commanding the trade route to Lhasa. Lower down the valley a powerful monastery owned most of the land. The Bhutanese and Sikkimese monks quarrelled for possession of the monastery and (regardless of Æsop) called in the rulers of Lhasa as arbiters. The natural result followed.

The Tibetans established their frontier 30 miles south of Phari, at Gnatong, enclosing the fertile district of Chumbi. The date of this occupation I cannot fix precisely. It took place apparently in the first half of the nineteenth century, between 1800, the date of publication of Turner's volume, and Hooker's travels in 1848. In d'Anville's and Turner's maps the frontier of Tibet is drawn just below Phari. In October, 1903, Sir F. Younghusband writes:—"Chumbi Valley is on the Indian side of the watershed, and is not regarded as part of Tibet." Mr. Candler says "the valley is beautiful beyond the beauty of the grandest Alpine scenery." "One might imagine oneself in Kandersteg or Lauterbrunnen." "There are long strips of arable land and villages every two or three miles." The elevation of this oasis between the fierce heat of the foothills and the bleak downs of the Tibetan frontier is from 9,000 to 10,000 feet.

In the occupation of Chumbi by Tibet, we acquiesced even after the Tibetans had in 1888 used it as a base from which to invade Sikkim. Yet it is only necessary to glance at a map to see that this wedge or tongue of Chumbi, lolled out Tibetan fashion at us across the watershed, is no part of Tibet proper. Nor are the inhabitants Tibetans; they are, as Mr. Candler has told us, a separate and oppressed race, who "were unaffectedly glad to see us in their valley." But up to to-day there is no sign that these obvious facts—which I was at pains to insist on in my book published in 1903—have been appreciated by our rulers, and I fear lest once more the indifference of statesmen in England to geographical knowledge may throw away the main advantages which should have been the legitimate fruit of the late expedition. The Chumbi Valley is all that Darjeeling is not. It furnishes a health station beyond the first fury of the rains. It supplies an admirable strategic centre for the ward of the frontier, while Darjeeling is an isolated hilltop from which the first move involves a descent of over 6,000 feet. Again, lying as it does on the great trade route Chumbi has every advantage as a commercial mart and exchange. It is the very spot for "the annual fair or bazaar to be held for two months in the spring at some place near the frontier" recommended by Dr. Campbell.

If the next Blue-book does not show that our Government is taking steps to establish such a mart either close to or within the Tibetan frontier we shall be driven to conclude that its policy is not to establish relations with Tibet, but to compel its population to remain as regards India in the isolation to which the steadfast policy of China has condemned them.

I do not overlook the general or particular objections to annexation. We should, it may be said, make enemies of the Tibetans. I wait for someone who has been to Lhasa to tell me that they would not prefer giving us a long lease of Chumbi to paying an indemnity. We should, it may be added, be breaking our pledges to Russia? But why did we give pledges? Apart from the question whether it was necessary to give any pledge to that Power, surely a statesman knowing all the facts must have limited his pledge to territory north of the Indian watershed, inhabited by Tibetans, and forming part of Tibet proper. In keeping Chumbi we should not annex part of Tibet, but recover a territory to which it has no claim but that of occupation.

I have spoken of Chumbi's important position on a trade route, a route of little more than 300 miles from the plains to Lhasa. This route will shortly be made a cart track throughout, for leave has been got from the Bhutanese to make a road through their territory which will reach Chumbi without crossing the Jelep La or any high pass. But a route is no use where there is no trade. I believe you will learn shortly that the prospects of trade with Tibet are by no means so hopeless as has often been asserted, that the people have something to sell as well as needs to supply. Sir F. Younghusband looks forward particularly, I am told, to the trade in wool. Sir J. Ware Edgar, in a very able Report written in 1873, insists on its importance. I have found a singular support for this anticipation in the *Journal* of your Society. As long ago as 1869 Dr. Alexander Campbell, Sir J. Hooker's companion, read a paper before the Indian Section on the prospects of trade with Tibet, from which I will make a few (I should have liked to make longer) extracts.

"The principal imports into Tibet are English broad cloths, cutlery, indigo, tobacco, sugar, rice, cotton, sheetings, castor oil, silk, crockery, &c.

"Wool is a very important product of Tibet, and may be looked to as a valuable export. In that country and the adjoining ones there are immense tracts of pasture land on which flocks of sheep in almost countless numbers are maintained. Seven or eight thousand sheep is a common number even for ordinary graziers to possess.

"The great elevation and cold temperature of these countries with the fine pastures produce very heavy fleeces of the finest wool, and of a very long staple quite as fine as the Australian wools, but more valuable for many fabrics on account of its longer staple. While at Darjeeling I procured several loads of this wool, and sent samples of it with rate of cost for trial and export to Calcutta and elsewhere. It was highly spoken of, and the industrial school at Jubblepore, in the Central Provinces of India, celebrated for its fine carpets, offered to send me a lac of rupees (£10,000) to be laid out in purchasing wool for them at the rates I had quoted. I need scarcely say it was not procurable, but the wool is in Tibet in immense quantity."

The Parliamentary papers issued last year will furnish more recent information to inquirers. Despite all the obstacles created by the Tibetans and Chinese, the trade has proved, on the whole, a growing one. I will be brief in my statistics. In 1890-1 the exports from Tibet into India amounted in round figures to 770,000 rupees, the imports to 401,000 rupees. In 1902-3 the figures were, exports 1,990,000 rupees, and imports 1,152,000 rupees. During the same period the value of the cattle exported rose from 25,000 to 80,000 rupees; of wool from 351,000 to 1,030,000 rupees; and of borax from 90,000 to 345,000 rupees.

It stands to reason that the demand for tea in Tibet, hitherto met by caravans making a two months' journey from China, could be met more advantageously to the consumer by the tea planter of Darjeeling or Assam. But apparently he has yet to learn to adulterate his tea so as to suit the depraved taste of the Tibetans. They prefer a bad quality, sweepings not sugared but buttered. If this obstacle can be overcome, files of tea carts ought soon to be climbing the new road to Chumbi.

I do not wish to exaggerate the trade prospects. Relatively no doubt they are insignificant, but I believe they are substantial. Moreover their political as well as their financial result has to be looked to. I say nothing about minerals, because I believe sufficient is not yet known to make any statement trustworthy.

The Sikkim gateway, the central gateway into Tibet, is for the time being the most available, but there are sidedoors which may prove important in the future. It would lead me too far afield to attempt to describe them. I must dismiss them in a few words.

Nepal and Bhutan close many routes known to the natives, among them that by which the

Chinese army advanced in 1792. West of Nepal there is a route from Simla now being opened up, we hope, by Captain Rawling.

Through Bhutan there are several passes kept shut to Europeans. Further east, through the independent tribes on the verge of the great bend of the Brahmaputra, there is another route. This, Sarat Chandra Das, the native agent of the Indian Government, to whom until last autumn we owed our only recent account of Lhasa, wrote to me a year ago, he was most anxious to see investigated.

To link the Sanpo of Tibet with the Brahmaputra of Assam, to ascertain the character of the great gorge by which the river cuts the Himalaya, is one of the most interesting of the geographical problems on the earth's surface that remain to be solved. I feel assured that two such ardent geographers as my fellow medallists of the Royal Geographical Society, Lord Curzon and Sir F. Younghusband, are not the men to have willingly lost an opportunity to solve it. Why, when Captain Rawling was sent up the Brahmaputra to the furthest end of Western Tibet, was not another party sent down the river to make this long desired discovery? Why (as Mr. Candler tells us), after every preparation had been made, after the Lamas had given consent, after Mr. Needham, the highest local authority on all matters in Assam, had pronounced the risk small, and proposed to co-operate, was the expedition suddenly stopped by orders from Simla? I am not in a position to answer the question, but I anticipate that we shall be told statesmanship has nothing to do with geography (which is too often true), and that the gain did not justify the risk. The answer will, in my opinion, be inadequate, for the injury is not to science alone. The opening of a route in this direction would be a matter of commercial and political importance as well as of geographical interest. The eastern end of Tibet, which would be opened, is said to be the most fertile and populated. May we not hope that the expedition is only postponed until next spring? With the assent of the authorities at Lhasa, which was not withheld, Chandra Das assured me a small escort, say 200 to 300 men, would suffice to protect the survey party from any hill tribes it might encounter.

With regard to these west and east gates of Tibet, I am, I find, only echoing what was said by Lord William Hay, the Chairman of the meeting when these matters were discussed in 1869. He urged the survey of the Assam route and the completion of the road from Simla.

In every little war waged on the world-wide frontiers of the Empire, we run two risks: First, that we should undertake the business in hand with inadequate preparation. This has been avoided in the present instance. Next, that we should miss the fruits of our success owing to the timidity, or carelessness, or lack of geographical insight in our statesmen, or the divided counsels of the home and local Governments. Let me quote once more Dr. Wegener. He writes:—"Without doubt the arrival of the English at Lhasa is an epoch-making event in the history of Asia, the results of which will be awaited with the keenest interest. But this English expedition is not yet brought to a conclusion. England has still to secure the political fruits of a military action, which it must in fairness be acknowledged has been brilliantly carried through, and this must involve many difficulties and perhaps some unforeseen incidents." May we still hope that in the case of Tibet these difficulties may be avoided: that we may have no "regrettable incidents" to record; that we shall see the Chumbi Valley leased to us, and a garrison and a trade-mart established in it; that the needful steps will be taken and persevered in for promoting commercial intercourse with Tibet, and thus acquiring a political influence over our interesting neighbours which may tend to the peace and happiness of all concerned? If we do none of these things, well (I will venture to prophecy) we shall soon be on the march again to Lhasa.

On all these matters we shall have an opportunity before long of hearing at the Geographical Society the experience and the views of Sir F. Younghusband. We shall doubtless soon learn much more from the important work promised by Mr. Landon, *The Times* correspondent. I have only done my best, under some difficulties, to give an outline of the earlier knowledge of the region. I must turn to the tour my photographs illustrate, my own tour, which happened to be the first made by Europeans round Kangchenjunga. I have described this journey at sufficient length in a book, and I shall attempt no connected narrative this afternoon. I may, however, give a few leading facts before I proceed to show and comment on the beautiful series of photographs (I can only show a small percentage of them) taken by my companion, Signor Vittorio Sella.

The permanent obstacle to this excursion from Darjeeling has been and is the fact that all the western side of Kangchenjunga lies in the forbidden State of Nepal. We evaded the Nepalese guards by crossing a very lofty snow pass of over 20,000 feet at the back of Kangchenjunga and traversing a region where for three weeks we met no human beings. The herdsmen had been driven down by what was to us an exceptional obstacle, the terrible storm which devastated Darjeeling and lowered the snow level on the Kangchenjunga group 3,000 feet.

Our outward route led us past Gantok, the capital of Sikkim, where the Raja holds his court in a massive stone building lately constructed by the Indian Government, and then along the road up the Tista Valley to the village of Lachen. Here we turned and followed to its utmost source under the precipices of Kangchenjunga the immense Zemu glacier. At 15,000 feet the great storm overtook us, and we turned north to find a passage into Nepal. Our course led us across two passes higher than Mont Blanc—this is a favourite phrase just now, but please remember that on the borders of Tibet a pass higher than Mont Blanc may be as easy as the Wengern Alp. We then penetrated the weird pasturage basin of Lhonak, which is the sort of place some people imagine all Tibet to be—a broad bare basin encircled by snow and ice. It took us five days to get over the chain connecting Kangchenjunga with the Himalayan tableland. Below the snowlevel on the Nepalese side, we discovered another trunk glacier grander than the Zemu, if not so large. We passed close under the mighty cliffs of Jannu, and at Khunza, in Nepal, touched Sir Joseph Hooker's tracks, having supplied the missing link in his travels. Our return to Darjeeling was over known ground.

The whole tour took about seven weeks and involved a prodigious amount of up-and-down work. But we met with nothing that could be called a mountaineering difficulty according to the standard of the Alpine Club. Apart from the snowstorm our difficulties were difficulties of transport and commissariat.

There is a suggestion I would venture for the benefit of future travellers in this enchanting region. If the Indian Government could spare funds to make a horse-track from Tonglo to Jongri and from Jongri to Yoksun, and repair the bridges, it would bring within the reach of every visitor to India one of the most beautiful "round-tours" in the world. If a trail could be cut through ten miles of forest above Zemu-Samdong the glories of the Zemu glacier, of Kangchenjunga's northern cliffs and Siniolchum's snows would be rendered accessible to travellers. It is a small matter, and I fear too æsthetie for official notice, unless indeed it should find favour in the eyes of the present Viceroy.

I shall venture a second suggestion of greater general importance. Much new geographical information, if not so much as we had hoped, will be brought home by the surveyors attached to the recent expedition. I am told that the maps embodying this knowledge are likely to be considered confidential. I do not question the expediency in certain cases of keeping back large scale maps that might be serviceable for military purposes. But if the Tibetan frontier is held to be a locality where this precaution is essential, I trust that secrecy will not be carried at Calcutta to the length it has been sometimes in the past, and that the new maps will be allowed to be used as material for the correction of ordinary atlases. When this is not done errors, that have been proved to be errors, are liable to remain uncorrected in atlases (the scale of which renders any danger of their serving for military purposes wholly imaginary) of the highest authority among their class. In such cases a properly organised department should find no difficulty in supplying atlas compilers with the information they need to make their maps correct without divulging dangerous details. Both on scientific and public grounds, therefore, I feel it desirable to take this opportunity of expressing the earnest hope of all geographers that in the case of the Tibetan expedition only such restrictions as may appear indispensable to the highest authorities, military and civil, will be imposed on the promulgation of the fresh facts ascertained by its members.

DISCUSSION.

The CHAIRMAN expressed his own, and he believed the general conviction, that Mr. Freshfield had not only charmed his large audience with his paper and his photographs, but had also infected his hearers with his own enthusiasm, and sent them away with much food for reflection. Part of his suggestion concerned the future commerce and political relation of Tibet. Into that region it would be premature to enter, not only because, as the author had said, we were expecting a lecture in another place from Sir F. Younghusband, but also because the public were

awaiting the issue of a second Blue-book, which might give us surer ground for conclusions and speculations. Meanwhile a host of other considerations presented themselves for discussion. Mr. Freshfield was too modest to enrol himself in the corps of Anglo-Indians, but he need not hesitate, as he had shown that he possessed all the qualifications needed for enlistment. In the first place, he had caught the spirit which moved all our countrymen engaged in work in India, an overmastering energy which sniffed the air of enterprise, faced difficulties, and threw all the physical and mental energies of the worker into his own field of action. The Himalayas called to Mr. Freshfield to penetrate their recesses and overcome all obstacles, as the deserts of Sind called to the irrigation officer to turn sands into gardens, or famine challenged the relief officer to save his fellow subjects at all cost, or the administration of justice and the promotion of the welfare of millions appealed to the civilian to live laborious days and reap the great reward of duty done in a vast field of activity. It was just the same essentially Anglo-Indian spirit which induced so eminent a climber as the author of the paper to scale heights few Europeans had attempted to reach, and solve, in the interests of science and geography, some of the great problems of nature. One civilian, Mr. A. B. Carey, who had received the highest reward of the Geographical Society, had felt the same call to penetrate the secrets of the Himalayas, and he approached the subject from the same standpoint. Having taken up the challenge, he proceeded on short privilege leave to England, and fresh from his voyage and the heats of the Red Sea, stepped aside for a few hours on his journey from Marseilles, walked straight up and down the Matterhorn, immediately resuming his journey home; and on the strength of that unique and solitary experience of the Alps he returned to India to spend his next long leave in crossing the Himalayas into China. Mr. Freshfield's experiences, in the second place, were those of most Anglo-Indians. As soon as he began to overcome difficulties, and entered the abode of eternal snow, he was told that the gods of the mountains would be offended; and that he could only advance by running counter to the superstitions and beliefs of the native inhabitants of those regions. His footsteps upon the pure untrodden snows were in fact regarded as a desecration. Every public official in India, from the West, had to encounter the same risk, and do his duty at the cost of giving similar offence. The Chairman recollected that when he was taking up land to form the bed of the great Bhatghar reservoir, the priests refused to allow a small temple to be acquired, and insisted that the impious acquirer of these sites would be stricken with disease and death by the offended gods. In fact, at that time, every effort to move the temple elsewhere, or to acquire it at a price, failed. In abolishing slavery and suttee, in opening schools to all castes without distinction, in punishing breakers of the law, without respect for caste, and even in admitting all travellers into our railway carriages, Western systems still daily offended against Eastern ideas. Happily, Mr. Freshfield had found the consolation which his impious intrusion into the secret places of nature brought to him. He had felt and shown to the natives that their fears were really groundless. Even the gods of the eternal mountains had not resented his intrusion. He descended from the roof of the world with more piety, more sense of the "divine architecture," and a deeper "spiritual attraction" than he took with him from the sea-level. That also was the experience of the Anglo-Indian who constantly incurring the "patient deep disdain" of the East, and offending the natives' susceptibilities in the discharge of his duties, was at length rewarded by their appreciation of his work and altered mind towards him. The contrast of the Eastern and Western minds was further illustrated by the history of Sikkim, to which the author had referred. We associated the mountains with the voice of freedom and ability. But the Lepchas of Sikkim had known little else than slavery and forced labour. When Hooker and Campbell were taken prisoners in 1849 by the Rajah Minister, an attempt was made to force the British company to recognise slavery, and restore runaway slaves to their masters in Sikkim. Isolation, and not liberty, was the spirit that reigned on the road to Tibet. Whether the passes which the author had shown on the slides would become highways of commerce, the Chairman would not prophesy, but he joined heartily with Mr. Freshfield in the hope that geographical knowledge had been increased by the late expedition, and that in due course the Government of Nepal would welcome alpine and other artistic tourists to its mountain peaks.

Mr. J. D. REES, C.I.E., said he did not propose to follow the author over "The sky neighbouring mountains of milk snow," or to trench upon politics, which the Chairman had wisely kept aloof from. He only wished to refer to one matter. Mr. Freshfield had told them that in former times a Chinese army had come over into Tibet, and he had said what the Chinese had done in former times they could do again, and so could Russia. Russia was very much occupied, and nobody would be likely to think that it was going to bring an army over that way; but at the present moment it did seem to him that there was such a disposition to take seriously that absurd bogey the yellow terror that he really hoped the author would explain that he did not mean that the Chinese might be expected any moment to go into Nepal or Tibet. Quite recently he had heard Baron Suymatso give a very interesting lecture upon the relations between China and Japan, and he pointed out that those two countries were absolutely antagonistic to each other; that the Chinese never could combine to attack a Western country, and that their sole desire was to keep away from Western countries. Those things were probably known to all present, but there was such a dispo-

sition, dressed up by the Russians for public consumption, to take that bogey seriously, that he hoped Mr. Freshfield would explain that there was no prospect of a Chinese or Chinese-Japanese invasion of Tibet. It was worthy of notice because at that lecture Baron Suymatso's remarks were received in silence, which, as Sir West Ridgeway remarked, gave consent; but at a time like the present, when the bogey views were put seriously forward, it was perhaps worth while for some one in authority to repudiate them. The author had said nothing about gold in his paper, which was to be found, he believed, in Tibet in large quantities. He had referred to the depraved taste of the Tibetans in taking butter in their tea, and he might have mentioned that the Indian tea planters were quite capable of furnishing a rough leaf of that class which was very suitable for taking with butter, as well as of producing the more delicate tea which was consumed in this country with such pleasure. He hoped that steps would be taken to introduce Indian tea into Tibet, in the same way as when our rivals in the East obtained any influence in a country, they used it for the introduction of the products of their industries. It would be very presumptuous of him to criticise anything that had been said by their eloquent and able Chairman, but he was bound to say in all seriousness, that he (the speaker) believed it was unnecessary for every Anglo-Indian to offend the susceptibilities of the natives. There were very difficult cases sometimes, no doubt, such as the taking of the temple without payment, to which Sir William had referred, in order to make a water supply that would save many lives; but he thought the Chairman had spoken with some picturesqueness, at any rate, when he laid down his doctrine on the point. For his own part, he believed that it was perfectly possible to live in India for many years, and not offend the susceptibilities of their fellow countrymen.

Mr. Freshfield, in reply, said he must thank the Chairman for the very kind manner in which he had welcomed him into the noble society of Anglo-Indians. He would like to say that the most vivid impression made on his mind in India was the magnificent service which Englishmen were doing for civilisation, and the happiness of the millions of that country. He saw India under exceptional circumstances, for it was at the time of the famine. The way in which Englishmen tried to save the unfortunate natives was something more than devotion; it was heroism. The feeling that he came back with was that one of the noblest careers in the world was that of an Anglo-Indian. With regard to his having offended the susceptibilities of the natives by his travels, he would remind his audience that there were two theories put forward. One was that the destruction wrought to Darjeeling was due to his offending mountain deities. The other was that the military commander there had fired cannon on a sacred hill. In the end the military commander was held to be the guilty person. The natives who accompanied him on his journey were not dissatisfied, and they told one of his companions that they were ready at any time to go again with the mad Englishmen who liked to build villages in the snow, because they were treated well. With regard to gold, he did not mention it because he knew nothing about it. With regard to tea, he had made his remarks about the difficulty of getting it from India, because he was lately talking to Major Le Mesurier, who had been Commissioner at Leh, and he said the great difficulty was that the English tea merchants had not learnt how to make tea to suit the taste of the Tibetans, and he added that he had written so many reports on the subject that he was thoroughly sick of it. With regard to China and the "yellow peril," he wished once for all in the most emphatic terms to say he had not the slightest fear of it. If Mr. Rees would look at the pamphlet he held in his hands by Dr. Wegener he would see why they might be afraid of China as an instrument in the hands of Russia. If Russia did not send troops, she might send officers to drill Tibetan troops; and to have any hostile force within 400 miles of Calcutta would be highly inconvenient. Moreover, every Indian official would agree that hostile intrigues in Nepal and Bhutan would be very disagreeable to the Government of India. That was the point of view from which he thought English influence should be paramount in Tibet. He thanked his audience for the extreme courtesy and patience with which they had listened to him.

The Chairman said he should like to add one personal remark. When he said they offended the susceptibilities of the natives and that this conflict was inevitable, he had added that he hoped they would eventually come to see that the English were right. As a poet had said—

> "The East bow'd low before the blast,
> In patient, deep disdain;
> She let the legions thunder past,
> And plunged in thought again."

And that was to some extent still the present state of affairs.

A cordial vote of thanks was passed to Mr. Freshfield for his interesting paper.

EIGHTH ORDINARY MEETING.

Wednesday, February 1, 1905; Sir Robert Hanbury Brown, K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Ahrlé, F. H. C., 82, Cavendish-road, Harringay, N.

Basden, Rev. George Thomas, B.A., Church Missionary Society, Onitsha, Southern Nigeria, West Africa, and 112, Caversham-road, Reading, Berks.

Black, Captain John Cameron, A.M.I.N.A., The Scottish Shipmasters' and Officers' Association, 128, Hope-street, Glasgow.

Doe, Austin, 42, Claremont-road, Forest-gate, Essex.

Gyles, Nathan, 8, Young-street, Doncaster, Yorkshire.

Hasluck, Paul N., "Ebor," Redhill, Surrey.

Heath, Henry, 2, St. Swithin-street, Worcester.

Kelly, Major Arthur D. D., Weston, Duleek, Co. Meath, Ireland.

Leggatt, Mrs. E. O., 15, Savoy-court, Strand, W.C.

Macfadyen, John Beith, 65, Apollo-street, Bombay, India.

Mackenzie, Alexander, 19, Greenhill-gardens, Edinburgh.

Robertson, Duncan, Forres-park, Trinidad, West Indies.

Skinner, George, A.M.I.Mech.E., 19, Russell-street, Bolton.

Smith, Vincent, Sheffield-road, Chesterfield.

The following candidates were balloted for and duly elected members of the Society:—

Abrams, Herbert John Sinclair, Hutton Mount, Pattison-road, Child's-hill, N.W.

Adams, Alfred Adam, 16 and 17, Devonshire-square, E.C.

Bevan, William, A.R.I.B.A., Chief Government Architect, Public Works Department (P.O. Box 398), Government Buildings, Pretoria, South Africa.

Erikson, Anthony, Assoc.I.N.A., 20, Hummum-street, Fort, Bombay, India.

Evans, Captain Thomas Luther, 59, Broad-street, Bristol.

Fernandez, George Anthony, 43, Raffle's-place, Singapore, Straits Settlements.

Frick, Henry Edgeworth, care of Fore River Shipbuilding Company, Quincy, Massachusetts, U.S.A.

Harwin, Albert Edward, Church-street, Pietermaritzburg, Natal, South Africa.

Hoare, Frederick, 251-254, High Holborn, W.C.

Hynd, John, Consolidated Goldfields of South Africa, Ltd. (Box 67), Bulawayo, Rhodesia, South Africa.

Kelly, John Forrest, Ph.D., Pittsfield, Massachusetts, U.S.A.

Kerr, David Gillespie, The Canada Corundum Company, Ltd., Craigmont, Ontario, Canada.

Khras, Minocher Jamshed Sohrab, Khras Bungalow, Middle Colaba, Bombay, India.

Kingston, C. Burrard, M.Inst.M.M., The Evancon Gold Mining Company, Ltd., Verrés, Val d'Aosta, Italy.

Landau, Miss Dorothea, 30, Bryanston-square, W.

Legarda, Vicente L., 208, Mason street, San Francisco, California, U.S A.

Morris, Rev. E. C., D.D., Ph.D., Helena, Arkansas, U.S.A.

Morrison, Charles, 53, Coleman-street, E.C.

Muir, David Temple, Pentlands, Castlebar-road, Ealing, W.

Oliveri, Joseph Giammusso, A.R.S.M., A.I.E.E., Caltanissetta, Sicily.

Pain, Robert Tucker, J.P., Ryll-court, Exmouth.

Pollock, George Frederick, Hanworth, Middlesex.

Reid, William Lewis, 160, Green-lanes, Clissold-park, N.

Roberts, Cyril, 1, Rossetti Studios, Flood-street, Chelsea, S.W.

Roberts, Richard Penberth, M.Inst.MM., Concession de Tama, Vezzani, Corsica, France.

Robertson, James Barr, The Oriental Club, Hanover-square, W.

Schäfer, Henry Thomas, 40, Brewer-street, Golden-square, W.

Suratwállá, Dr. Ardeshir Bamanjee, Chira Bazar, Bombay, India.

Thomas, Hon. J. J., M.L.C., J.P., Wilberforce-house, Sierra Leone, West Africa.

Trevett, Charles G., A.M.I.E.E., Messrs. Green and Trevett, 15, Castle-street, Cape Town, South Africa.

Tully, John Collingwood, F.R.I.B.A., Ardernes-chambers, Longmarket-street, Cape Town, South Africa.

Wecksley, Felix S., Bangalore, India.

Wedlake, George, Royston, St. Margaret-at-Cliffe, Kent.

Wright, Allister MacLean, 62, Harman-street, Addington, Christchurch, New Zealand.

The CHAIRMAN said it was a peculiar proceeding for one who was a stranger to have to introduce the audience to the Vice-President of the Society, but if they would understand the expression "introduce" in its Pickwickian sense he thought the term would apply. With regard to the subject of the paper, he was well qualified to introduce it in its ordinary sense, because for nineteen years he had had an intimate connection with the navigation of the Nile, and had constituted himself, to some extent, the champion of the boats when the railway administration sat upon them.

The paper read was—

THE NAVIGATION OF THE NILE.

By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

It will be seen from the map that the Nile is fed by four distinct catchment areas:—

1. The Southern Equatorial region that drains into Lake Albert Edward, and, flowing through the Semliki River and Lake Albert, joins the Victoria Nile at the North end of this latter lake.

2. The Southern Equatorial region that drains into Lake Victoria, and issuing from that inland sea forms the Victoria Nile, which, joining the discharge of Lake Albert, forms the Bahr-el-Gebel, and joins the White Nile at Lake No.

3. The North Equatorial region that drains into the Bahr-el-Ghazal, and forms Lake No.

4. The mountainous region of Abyssinia that drains into Lake Tsana, and feeds the rivers Blue Nile, Sobat, and Atbara.

From the Atbara to the sea there is no other tributary whatever, and from Khartoum, where the Blue and White Nile meet, to the Mediterranean this great waterway bears its historical name, "the Nile."*

The quantity of water that passes Berber, a few miles north of the mouth of the Atbara, is but a small fraction of that which has fallen as rain or melted from snow in those vast areas that form its sources. Much supports vegetation, much is infiltrated into the ground, but much more is evaporated away by the fierce heat of the tropical sun to form cloud mist and invisible moisture. Certainly 90 per cent. of this water irretrievably disappears as vapour and never enters the Nile. One of the chief duties of the engineer is to recover some of this lost agent, and to endeavour to utilise it for the benefit and comfort of the cheerful, contented, and ancient population of the Nile Valley. The utilisation of this remnant for irrigation, fertilisation, cultivation, and domestic use, is in the hands of the most competent men in the world, who have not only the practice of 4,500 years before their eyes to study, but the experience of our great Indian dependency to follow, and the lessons of the Mississippi, the Danube, the Po, and other rivers, to mark and learn. There is much in these examples to follow, and more to avoid; but, first of all, there is one great deduction to make from the study of the past, and the observation of the present:—Nature as a rule rebels against hasty or careless interference with her ways, but she is generous to those who study her laws, follow her dictates, and apply her own operations with wisdom, caution, and common sense to aid the wants, comfort, and peaceful purposes of man.

The Nile is virtually embanked from Aswân to the sea. It is practically a canal, and should be treated as a canal. Its principal danger arises from floods, when the rainfall exceeds the average. Floods produce varying currents, and currents may become so strong that by sheer erosion they breach the banks and inundate the country at the wrong time. A high flood means that the river has risen one metre above the land in Upper Egypt, two metres in middle Egypt, and three and a half metres in the Delta. Breaches which at one time were common, are fortunately now rare. The Rosetta branch has not been breached for forty-two years.

The river is controlled by weirs, barrages, and dams. A *weir* is a submerged dam, used to raise the level of the water, so as to force or send it down a canal or the headrace of a millstream for power purposes. The modern term *barrage* is taken from the French, and implies the use of moveable gates in the openings. A *dam* is a weir provided with *sluices* fitted with controllable gates, which enables the level of the water behind it to be raised and regulated for the various purposes. The latest—the Aswân dam—is unique in this, that it can allow the whole flood of the river to pass through without check, and that it is put in operation only when the water has become practically clear of silt.

It is my purpose in this paper to deal principally with the question of the navigation of the Nile from Aswân to the sea, that is, the regulation of its currents, depth of water, channels, and banks, so that the motion of boats shall be possible in all times and seasons both up and down stream. Navigation is a question to which I have devoted a great deal of attention during the past fifty years of my practice as a submarine cable engineer. There are few parts of our coast, channels, firths, and rivers, that I do not know well. I have inspected the Mississippi, the Danube, the Rhine, the Po, and the Nile, and I am an active member of a committee dealing with the navigation of that extremely intricate and shifting channel, the Menai Straits, where many of the points I am going to discuss are vexed questions.

Egypt has always been a country of plenty and of famine, not alone in corn but in water. The Nile is unique in the strange periodicity of its water supply. Its annual rise and fall are most regular, but there are other periodical disturbances, not so regular nor so well known, which, according to Captain Lyons, R.E., the head of the Survey Department in Egypt, are associated with the meteorological vagaries of the Indian Ocean. These produce those high and low Niles which determined the seven years periods of plenty and dearth that wer

* The map of the Nile here referred to will be issued as a Supplement to the next week's number of the *Journal*.

recorded long before the day of Joseph, but which are now fortunately of longer periods.

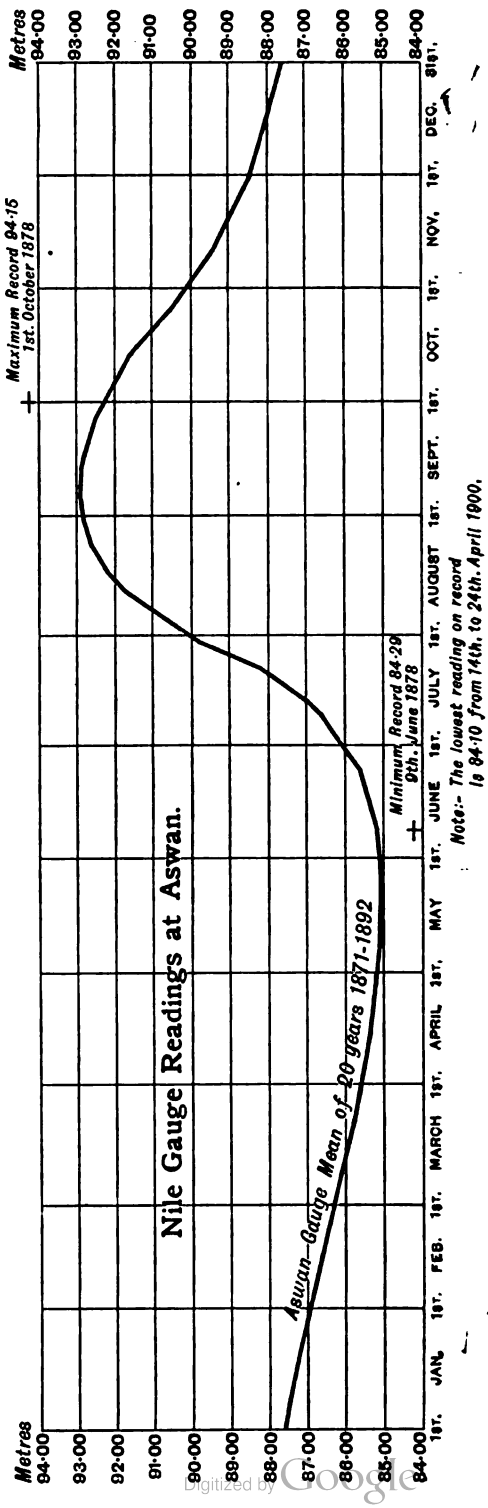
Only a small fraction of the water of the Nile that falls in its catchment basins passes Aswân. Fig. 1 gives the mean of the gauge readings at Aswân for the twenty years, 1871 to 1900. The low Nile is generally in the middle of May, and the high Nile always in the beginning of September. The lowest reading there on record is 84·10 metres in 1900 above the mean level of the Mediterranean Sea. The highest reading was in 1878, when the level recorded 94·15 metres above the sea. The range of the flood was thus 10·5 metres.

The metrical system of measurement is in use in Egypt, and for hydraulic purposes it gives us a very convenient standard—the cubic metre of water. This weighs 2,204 British pounds—very nearly our ton, and exactly the metrical *tonne*. If it were possible to agree with France on the adoption of a standard ton —say, a mean of 2,222 lbs.—we could make the metre a whole multiple of the inch, and all difficulties of the conversion of the one system to the other would vanish. The practical difficulty that confronts us now is the fact that the inch is an unworkable fraction of the metre. Make the metre equal to 40 British inches, and all troubles would cease.*

We are troubled at the outset with the fact that meteorological observations in Egypt have not been continuous or general. Nile-gauges at Roda Island (Cairo) and Aswân have existed, and their indications have been more or less noted for many centuries, but rain-gauges are quite modern. There are now many Nile-gauges and rain-gauges fixed under the observation of the extremely well-organised Survey Department at Aswân, Wadi Halfa, Khartoum, Dueim, Wad Medani, Gondokoro, and Jinja (Lake Victoria). They are sure to supply reliable facts in the future, as, indeed, they are doing now.

The Nile-gauge now used is a baulk of teak anchored to the slope of the river bank, and forming with the level of the water an angle o 30°. A scale of metres is marked on the exposed side of the baulk, and the readings, when multiplied by 0·866 (the cosine of 30°), gives the variable height of the water. The upright posts previously used were damaged by

FIG. 1.



* Distances in this paper will be given in kilometres. Approximately, metres are converted into yards by multiplying by 1·1; metres-square into yards-square by multiplying by 1·2; metres-cube into yards-cube by multiplying by 1·3. Kilometres are converted into miles by multiplying by ·62; kilometres-square into miles-square by multiplying by ·386.

boats and by hippopotamuses, and to prevent disturbance of the gauges from such accidents Capt. Lyons designed this form of gauge, which is now the standard pattern used.

The average annual rainfall in the great lake districts is about 50 inches. It falls over an immense area and for short periods. When the rain falls it comes down solid, and is most trying to those who are exposed to it. Even the ants have intelligence enough to build their hills in the shape of an umbrella or toadstool.

Rain-gauges are fixed, in Egypt, at Alexandria, Port Said, Helwân (Cairo), Assiût, Aswân; in the Soudan, at Wadi Halfa, Omdurman, Kassala, in Abyssinia: at Adis Ababa.

Much of the area in the Lake District is volcanic, and subsidence of the land as well as disturbances of the water throws some doubt on the accuracy of the records of the past in these quarters; but the rise and fall of the Nile is dependent solely on this rainfall, and these records are now reliable.

Lake Victoria is nearly the size of Ireland. Its area is 68,000 square kilometres (26,000 square miles). A fraction only of the enormous rainfall, viz., one-thirtieth, passes Aswân, 29 parts disappear by evaporation, absorption (infiltration in the ground), and vegetation, before they reach the White Nile.

The water which falls at the sources takes much time to reach the navigable portion of the river.

	Period of Low Nile.	Period of High Nile.
Lake Victoria to Lake Albert	8 days	8 days
Lake Albert to Lado	5 "	5 "
Lado to Khartoum	36 "	20 "
Khartoum to Aswân	26 "	10 "
Aswân to Cairo............	12 "	5 "
Cairo to the Sea	3 "	2 "
	90 "	50 "

Thus the rain which falls about the equator early in April passes Cairo in June. It is subjected all this time to the intense action of the sun's rays during the day.

A serious difficulty that obstructs the doctor and the engineer in Nile land is the excessive dryness of the air, which aids the sun in exciting such intense evaporation. The intense energy of the sun acting directly and continuously on the great expanse of waters, converts the water into the form of invisible vapour. This is absorbed at once by the dry air. This evaporation is the most potent factor in the water supply of the country. It has to be carefully considered in regulating the flow out of the Aswân Reservoir, and it must have some weight in determining the position of other reservoirs. A shallow tank of one square metre surface is exposed to the sun near the office of Mr. Macdonald, the Engineer in Chief at the Dam, but protected from the wind by its position, and from insects and disturbance by fine wire netting. Readings are taken daily, and the amount of disappearance of water carefully recorded. The mean results for the year 1903 are as follows:—

January ..	3·5 mm.	July	12·0 mm.
February..	4·8 mm.	August....	11·1 mm.
March....	6·0 mm.	September.	7·5 mm.
April	10·0 mm.	October ..	6·3 mm.
May......	10·8 mm.	November .	4·6 mm.
June	11·5 mm.	December .	3·5 mm.
	Mean .... 7·6 mm.		

The mean for the whole year is thus 7·6 mm. of water evaporated away during every day. This implies that in the hot summer months of June and July, when all the water is needed for irrigation and navigation, one third disappears between Aswân and the sea during its flow of 15 days. How much is lost between the Upper Lakes and Aswân? In the Upper Lakes, where equatorial cloud-belts obscure the sky, and the air is more humid, Mr. Dupuis estimates the mean daily loss at 4 mm. In Upper Egypt, according to Sir W. Willcocks, the evaporation has been found by other experimenters to be 7·5 mm. per day in summer. In Lower Egypt, where the humidity is much greater, it is only 3 mm per day in summer. Linant Pasha gave it as 9 mm. throughout the year, while in the Bitter Lakes (sea water) the French engineers gave it as only 4 mm. in summer. At Aswân it is 7·6 mm. throughout the year.

It is clear that more scientific and more extended experiments are needed to determine this most important factor in the commercial asset of Egypt's agricultural wealth.

The loss of water due to evaporation depends primarily on the intensity of the sun's rays, on the surfaces exposed to those rays, and secondarily on the depth of water, on the wind, and perhaps on the rate of flow of water. The factors are, therefore, the clearness of sky, the dryness of the air, the force of the wind, the temperature and direction of the sun's rays, the time of exposure, and the area of surface exposed. The length of the river remains fixed, but the width varies. The broader the river, the greater the evaporation. Thus, as the length of the Nile is fixed, and the quantity

of water that passes the Atbara River all that passes down, the portion of water that passes Cairo would be increased by deepening and narrowing the river. Anything that diminishes the width of the Nile is beneficial to the water supply, for it would check evaporation. Reclamation of land from the river would increase the depth of the river, for by narrowing its breadth it would strengthen the currents flowing, and therefore their scouring action.

Vegetation is another potent factor in determining evaporation. Living trees absorb moisture, which, rising through the fibres of the tree, evaporates away at every leaf and every flower. Sir William Garstin has pointed out that in the vast swamps, covering unknown areas, which line the Bahr-el-Gebel for a great distance between Gondokoro and Lake No, 750 km. in length, 60 per cent. of the water is lost by evaporation, and the higher the flood the greater the loss. The amount of water leaving Lake Albert is 646 tons per second, and that which enters the White Nile only 300 tons per second; the difference is due to tributaries. He proposes to reduce this terrible waste by making a new broad channel from Bor to the mouth of the Sobat, as shown on the map. It will be 340 km. long and big enough to carry 1,000 tons of water per second. This is a bold and desirable proposal.

Nile Mud.

The Nile in August is a river of liquid mud, derived principally from the erosion of Abyssinia. The information available on this fertilising silt in flood is meagre and unreliable. The tons of solid matter which pass through the dam every year are estimated roughly to number 50,000,000. Of these 30,000,000 are lost in the sea, while 20,000,000 only are utilised as manure. Thus, three-fifths of this valuable stuff is lost.

Silt in Suspension.*

	Gramme per m³.		Gramme per m³.
January	167	August	1,492
February	126	September ..	543
March	53	October.	378
April	66	November....	344
May	47	December....	289
June	69		——
July	173	Total ..	3,752

Mean 313 gr. per m³.
Total in year = 49,573,000 tons.

* *Cf.* Baker, "The River Nile." Min. Proc. Inst. Civ. Eng. lx., 1880, p. 367 (376), and taken June, 1874—May, 1875. 1874 was an exceptionally high flood. Copied from "Morphologie der Endoberflache." Penck. I., p. 301.

Careful scientific experiments are very much needed to determine more accurately than we know at present the laws determining the rate of deposition of silt and its variation with the velocity of water. Excellent experiments have been made on the settlement of sand in sea water, but Nile mud is *sui generis*. It consists of matter held in suspension in various sizes from those very fine particles which, on approaching the mouths of the Nile, give the water the green effect called *Eau du Nile*, to the heavier forms which, through the reduction of the velocity of the water, fall and form deposits of clean silver sand that appear as sand banks as we ascend the river. It is only when the muddy water is stagnant and evaporates away that the whole sediment is deposited. The heavier matter, that is the larger particles, fall and are deposited first, while the finest remain to the last, and this natural sifting process is simply a question of the rate of flow of the water. It thus follows that the strength of the currents, the diversion of the water over the land, and its evaporation are such important factors in the successful irrigation of the Nile Valley.

It would appear from Sir W. Willcocks's experiments on canals, that there is no deposit of mud when the velocity exceeds ·7 metres per second (one and a half miles per hour), but as this speed diminishes so does the rate of settlement increase. On the other hand, if the velocity increases to three or four metres per second, as it does in unregulated canals, the water scours away the already deposited matter. This was cured by maintaining a constant current of about one metre per second (two miles per hour). . .

This is what is wanted in the Nile. The principal problem to be solved is how to maintain its own current at a greater velocity than that which causes settlement, and so maintain the depth of the river, and how to prevent the increase of this velocity so as to save the erosion of the banks.

The Aswân dam has shown how to do it, and the Wadi Rayan appears to be an eligible depression to enable a second reservoir of the same storage capacity to be installed. It is a matter under discussion, and serious objections, geological and financial, have been urged against its adoption; but let us hope that these objections will disappear under careful scrutiny and survey, for no more eligible position could possibly be secured for such a desirable scheme to supplement the

Aswân reservoir, since it would reduce the evaporation difficulty to a minimum.

The silt which is carried into the sea and lost there is due, not only to the sources of the Nile, but to the erosion of its banks. This increases with the velocity of the water sweeping past banks that have been cut to pieces by Shadûfs—those ancient water-lifters so prominent in Upper Egypt, but are absent where perennial irrigation has been introduced. [Shadûfs and Sakias are shown by slides.] It would seem from present statistics that the mass of solid matter held in suspension passing Cairo is virtually the same as that passing Aswân, from which it follows, if true, that erosion supplies as much solid matter as irrigation utilises. This is also shown by the fact, which I have myself noticed, and every one who uses a bath on the Nile steamers must find the same, that while the water is quite clear at Aswân, it is thick at Cairo. Indeed, no one can pass down the Nile at this time of the year (January) without being forcibly struck by the destruction of the banks. The reduction of the acreage of the river from this cause is called *akl-el-bahr*—"the eating of the river"—and it is admitted by the Government as an excuse for the reduction of taxation.

A careful examination of the splendid maps which are now being issued by the Survey Department of the Nile Valley, shows clearly the immense loss of energy and of matter there has been in the past through the friction of the liquid mud (for at times the Nile is nothing else) against the friable banks, and the absence of any means to restrain or reduce it. Every bend, every bank, and every backwater is a silent witness to what has been going on from time immemorial. (A section of the river from Aswân downwards placed on the wall illustrates this.)

Although a great many borings have been made to determine the thickness of the alluvium of the Nile, they do not teach us very much. Samples of these borings are to be seen in the Public Works Museum in Cairo. They show that the original floor of the valley was very uneven, and there may have been a deep inroad of the sea even up to the Fayum, some say as far as Esneh. We have not sufficient information at present to frame even a theory. We want a series of bores in lines across the valley at fixed intervals on carefully selected sites. The present rate of deposit is about 0·12 metre per century. If this has been going on for 4,000 years it means a rise of the river bed of 4·8 metres. There may also be a rise of the valley floor. We have no history of the change of slope, but the slope is certainly diminishing, the current of the river is slackening, and the rate of deposit is increasing, and there is trouble ahead if these questions are not tackled seriously and scientifically.

A vital point affecting the industry of the country is the navigation of the river, and the regulation of its depths, channels, and currents.

The influence which the Dam is to exert on the navigation of the Nile has received scant attention up to the present, as far as I have been able to judge. It was designed and intended to further the irrigation of the country. It has, however, a very important bearing on this interesting branch of the subject.

The construction of splendid locks, shown on the screen, has rendered the navigation of the First Cataract perennial, and this must be an inestimable advantage to the population upon the upper reaches of the river north of Wadi Halfa. I purpose, however, to refer to the portion of the river from Aswân to Cairo, apart altogether from the protection from floods, which are well in hand. Here the hindrances to navigation are the want of water at low Nile, the strong currents at full Nile, the closing of bridges, the incessant changes of the channel, the formation of shoals and banks, the constant deposition of matter in the wrong place, and the silting up of the river. With a variable flow of water, an increasing width of river, and a variable channel there must be constant changes of current in direction and strength. Where the river broadens, the speed must slacken, and the silt must fall, and thus we have the incessant formation of islands and banks. The river cannot be ascended without the constant use of the sounding rod, while the Arab pilot seems to have an instinctive knowledge of changes in the channel by the changes in the currents and the appearance of the surface. The Nile has one inestimable advantage beyond the control of man—the persistent north wind. This was appreciated so much by the ancient Egyptians that it was deified and symbolised by them as a beneficent power. The river is the main artery of the life and commerce of the country. All important towns and villages cluster on its banks. It is one brilliant scene of white-winged dahabiehs, gaiassas, markebs, and filukas, laden with human beings, agricultural produce, and manufactured goods. The stately steamer plies with its complement of sight-seeing, peering, restless tourists, and the mail steamers and express boats maintain a regular

service of postal and commercial communication. The number of boats of all classes exceeds 22,000.

I have seen no evidence whatever of any engineering operations in hand, either to maintain the depth or to train the currents so as to keep the channels in their proper course. I have not even seen a dredger at work, but my line of inspection has been confined to Upper Egypt. On the other hand, the destruction of the banks by the Shadûfs is only too apparent.

There are no charts of the river, nor is there any systematic survey in hand. I doubt if any other river in the world is so badly treated. The owners of 22,000 boats would surely submit to a small taxation of £1 per boat per annum to secure better information than they have now, and some attempt at buoying, marking, and beaconing channels.

The Americans have fully recognised the necessity of dealing with obstructions and floods. The Mississippi is virtually a canal from St. Louis to New Orleans. The banks are pitched at a very low angle by what are locally called "levees." They not only meet the case of floods, but they maintain the river in one channel, with navigable depths and with regulated currents. The outlets of the river to the sea have been opened by dredging.

The works which appear to me to be required to improve the navigation of the Nile are:—

1. The removal of obstructive banks and shoals. It has been found in the Severn that the removal of shoals (submerged banks) and the deepening the bed of the river by dredging has led to a marked increase in the flood discharging power of the river. The navigation has also been greatly improved.

2. The river banks in certain places where they are subject to erosion want to be well pitched to prevent this erosion, and to maintain the proper direction of the current. An admirable system of pitching is to be seen near the landing stage at Asyût.

3. Quays want to be built at all towns where commerce is active, goods are landed, and passengers embark and disembark.

4. Shadûfs and Sakias require to be abolished, especially the former.

5. Training walls are needed to direct currents in useful directions. The following conclusion was adopted by the 7th International Congress of Navigation at Washington in 1898:—

"The increase of depth effected by dredging, combined with the rectification of the banks, may, under certain circumstances in the condition of the régime of a river, furnish a satisfactory solution, as shown by the results obtained upon the Severn in England."

6. New lands want to be developed by the deposit of the silt and by the dredging of the river on reclaimed banks and places.

It must not be forgotten that Nature has placed at the disposal of man certain useful working tools which he ought to work for his own advantage, and not, as is too often the case, neglect to his disadvantage.

These tools are:—

Erosion.—The scouring and polishing action of matter suspended in moving water. This depends on the quantity and weight of matter in suspension, and on the velocity with which it moves. Wind is also a powerful force when carrying sand. The action of the sand blast is very evident on every exposed rock. I have seen rocks in the desert rounded by the sand blast like the *roches moutonnées* left by the grinding glacier in the Ice Age.

Potholing.—But the most evident and powerful tool is potholing. Nowhere is this more evident than round and about the rocks at Aswân. There is one just opposite the Cataract Hotel, and close to the old Nilometer, which is still in use as the standard directing the operations of the engineers at the dam. This pothole looks like a comfortable arm chair, such as those used by hall porters in the seats of the mighty; but its seat is of Nile mud, mixed with stones, pebbles, and sand. It is 8 ft. 1 in. from the seat to the top of the back, and 6 ft. 6 in. across the seat.

The rocks are full of these holes. [I show several slides.] I went inside several and measured them. They are of all sizes, from 1 inch in diameter to 12 feet. The size depends probably on the size of the stone that commences the grinding, and the more rapidly it rotates the more rapidly is the hole made. There is no evidence of this rate of working. The grinder must be of harder material than the rock holed. Several have their stones inside them, and also water, but most have pebbles, silt, and sand. Many, like the arm chair, have a side broken off, and many are pierced through. Many are destroyed by weakness or rotten spots. They look for all the world like great pieces of black wood pierced by gigantic teredos. One had the grinding piece of diorite standing out. (Shown in Fig. 2.) The hole was full of deposit of sand and mud. I could not move

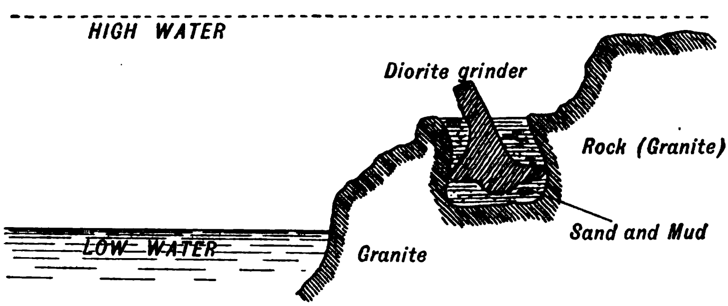
the grinder. This destructive action of "potholing" is very manifest.

There are two spots on the river—the one 1 km. above, and the other 2½ km. below the dam, where holes or pools of 40 metres depth have at some early period been scoured out by falling water. These show that waterfalls once existed here, and that the much-doubted statements of Diodorus Siculus and of Herodotus of the roar of the cataracts were probably quite true. The obstacles which caused them must have been removed by potholing. There are clear marks of a higher level of the river above the site of these falls. The same kind of thing is found at Semneh, above Wadi Halfa.

The following facts apply to Aswân. The distance from Aswân to Cairo is 900 km., and to the sea 1,262 km. The slope of the river is:—In the First Cataract, 1 in 1,000; between Aswân and Cairo, full Nile, 1 in 10,800; low Nile, 1 in 13,000. The mean velocity of the water is:—In full Nile, 2 to 1 metres per second; low Nile, ·7 to ·3 metres per second.

The current in the Nile ought not to exceed 2 metres per second, or to be less than ·7 metres per second; the former to prevent the stoppage of the ascent of the river by boats, and the latter to prevent deposition of silt. The mean width of the river is now 900 metres. The flow of water is:—In full Nile, maximum, 13,200 tons per second; minimum, 6,500 tons per second; mean, 10,000 tons per second. In low Nile, maximum, 1,300 tons per second; minimum, 210 tons per second; mean, 410 tons per second. The reservoir at Aswân has increased this minimum to 410, and the mean to 755. The reduced water level—that is, the height above the mean sea level—is:—Full Nile, 93 metres; low Nile, 85 metres; the mean range difference between the two being 8 metres.

FIG. 2.—POTHOLE.



The Aswân dam was designed to hold up water to the level of 106 metres, so as to store up 1,000,000,000 tons of water, but it is found strong enough to hold up 107·05 metres. It is now intended to raise it so as to hold up 112 metres, and this will enable it to store up 2,000,000,000 tons of water. This is a "consummation devoutly to be wished," and a fitting crowning of this great work.

There are two other great works in contemplation, and probably by this time authorised. The one is the opening of the new channel from Bor to the Sobat river, so as to shunt away the Bahr-el-Gebel with its "Sudd" obstructions and its wasteful swamps. "Sudd" is a collection of papyrus and other reeds, swimming plants, "Bus" and "Umsoof" (mother of cotton) roots and stems, so compact and firm as to be impenetrable and able to hold up the water. Its depth varies from 2 to 6 metres and its length is often measured in kilometres. The Bahr-el-Gebel was impassable owing to these obstacles. The longest obstacle was 36 kilometres, the next 12 kilometres, and the others varied from 2 kilometres to 600 metres. They were removed by cutting the surface into rectangular blocks, hauling these out by steamers, and letting them float away down stream. They disappeared by disintegration. The second is the improvement of the Rosetta and Damietta branches in the Delta, so that the former can carry away to the sea the dangerous flood waters, and the other maintain the navigation and irrigation of that part of the country. Other works of canals and drains must necessarily follow these great works proposed ultimately, but in the mean time in Upper Egypt 750,000 acres of basin land must be converted into perennial irrigation, and this will make historical, I hope, the Shadûf on the Nile.

The improvement of the navigation of the Nile will benefit a large community, and it is a question whether the cost of the perpetual opening of the river should not be paid for by those who would profit so largely by it.

Since 7 mm. is the mean daily loss of water due to evaporation, every square metre must lose a ton of water in every 143 days, and, therefore, 2½ tons of water per annum escape from every square metre exposed. Now, a feddan of land means roughly 4,000 square metres, and, if reclaimed from the river, it practically adds to the river 10,000 tons of water per annum to sustain the current and to diminish the call made upon the reservoir at Aswân for water during low Nile. It is pure gain, for it diminishes the surface and adds to the depth. It also adds one feddan to the cultivable land for the growth of crops, and, therefore, it adds to the wealth of the country. The reclamation of land from the river is thus a pure commercial advantage as well as a prudent and political measure for the benefit of the navigation and the maintenance of the river. There are many places on the river where this could apparently be very easily, if not profitably, carried out. Aswân itself is one. Such a growing place and favourite health resort wants a proper quay, with landing-places along its river front, and a well-equipped market for its imported produce. There is a great sweep of waste land on the east side, covered by flood and exposed in low water, which could be reclaimed by a revetment in front of the town and a levee, and which would add many feddans to the land and supply many thousands of tons of water to the river. There are many other places on the river where this could be done. Is it worth while, and does it come within practical politics?

The Aswân reservoir extends up the river for 224 km. The mean breadth is 900 metres. This makes the surface roughly 200 square kilometres exposed to the sun's rays for about four hot months. This would cause a loss of 20 per cent. of the water stored. When the water stored is doubled by raising the dam, the surface exposed will not be nearly doubled and therefore the ratio of loss will not be so great. In fact, in these hot countries we should rely more on depth and less on surface when forming reservoirs. The loss in that natural reservoir, Lake Victoria, is 55 per cent. of the water that enters the lake, in Lake Albert 60 per cent. and in Lake Tsana 55·5 per cent. The loss on the river between Lado and the White Nile is 62 per cent. This, as Sir W. Garstin says, "is an appalling waste of water."

The chief point for careful consideration appears to me to be not only the control of the water, but the control of the silt. Thirty thousand tons of valuable mud are lost in the sea every year, and the rise of the bed of the river in the Delta is a very serious question. Navigation is thus checked, but the remedy is at hand. The outlets are to be cleared by dredging. More sediment will be utilised on the land. Currents will be regulated by storage and barrage. Floods will be under better management. But what is most urgently needed is the protection of the banks, the training of the river, its maintenance in well defined limits, a depth navigable in all seasons, and a call on Nature to assist man to regulate this precious water communication for his daily service.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said the author's interesting paper had carried him back to the scenes of his labours extending over a period of nineteen years. He confessed to a certain surprise in the paper, for he had expected to hear something about electricity in connection with the navigation of the Nile, but not a word had been said on the subject. Sir William mentioned the Zifta barrage, and asked him (the Chairman) to describe it; but there were so many pegs upon which to hang a discussion, that he thought he had better decline the invitation, and confine his remarks to the subject of the paper. The author had rightly called the Nile a canal below the Aswân dam. The Aswân dam constituted the head work of the chief canal of Egypt, which was the Nile below it, and the Assiût barrage, the Delta barrage, and the Zifta barrage, were so many regulators on the main canal, while the so-called main canals which took off from above those barrages were really branch canals of the main natural canal. It was a perfectly correct view to consider the Nile below the Aswân dam as a canal, and it should be considered as such. The purpose of the paper he took to be the advocacy, the training of the Nile, with two objects—firstly, to lessen the loss of water which took place by evaporation in consequence of the excessive width of the Nile in its summer channel; and secondly, to improve the navigation conditions by deepening the summer channel so that boats could more easily navigate it. He had had some experience in India of training shallow rivers in summer so that they might preserve a minimum depth suitable to the traffic which had to pass along them. The first thing to be done was to stop all erosion of the banks, and secondly, after the erosion of the banks had been stopped, to narrow the natural channel so that it might deepen itself. Some

years ago a certain amount of money was given to him to make an experiment with that system on the Nile, but it was given so late in the year that it was not of much good. Enough, however, was done to show that if the system were applied to certain reaches on the Nile, and supplied in time, it would be most efficient in producing the effect desired, *i.e.*, deeping the central channel. The experiment was not repeated because it required so much money; and there were so many things in Egypt which required to be done more vital than the Nile navigation, such as irrigation, that the money was spent on them, with the result that the navigation had to wait. Times had now changed; there was more money and more water in the summer time in the Nile, so that for both those reasons it might be found easier to undertake the training of the summer channel, which the author, he imagined, wished to advocate. He thought Sir William was a little hard on the Sakias and Shadûfs, because he did not think they had anything like the destructive effect the author imagined. Sakias and Shadûfs would always be found erected on the stiff clay banks of the river, where the erosion did not take place, because if they were to set themselves up on the curves where erosion was acting energetically, they would soon find themselves in the deep water under the bank; consequently, a place was nearly always selected where the clay was stiff, and the Nile erosion had not much effect. He also thought Sir William was incorrect in saying there were no Shadûfs in Lower Egypt. It was true there were no Shadûfs where there was free-flow irrigation, but where there was perennial irriga-which had to be lifted, Shadûfs would be found in very great numbers, and not a few in the north part of the Delta. The first step in the improvement of the summer channel of the river was to stop erosion, and in that direction the Government had already done a good deal at the worst points. They had made spurs to stop the river encroaching on its banks, not so much with the object of training the river, as for protecting threatened points which it was important to protect, such as the railway and important villages; so that something had been done towards the training of the river by the stopping of the erosion. The training of the river was a very expensive business, which was the reason why it had not been undertaken before. In Lower Egypt it had been decided to take in hand the Damietta and the Rosetta branches, and to protect them thoroughly, so that there would be no danger of the Nile banks ever breaching, and when that was done perhaps more money would be spent in Upper Egypt in the same direction, and a commencement be made with the training of the summer channel of the river. There was only one place at which a deliberate attempt had been made to train the river into a channel in which it would not naturally go, and that was above the Delta barrage. For some years operations had been carried out for the purpose of endeavouring to induce the river to take to channels which would flow on to the barrage in regular lines which were laid down on a map, and which they had been trying to force it to take. He believed that £3,000 a year had been spent on it for something like 15 years, and it was not yet done, and taking that expenditure as a guide to the whole of the river, it would take a large sum of money to carry out the work. The author also mentioned that the foreshores and certain shallow places in the river should be reclaimed from the river so as to protect the channel. A beginning had been made with that work, a concession having been given to the New Egyptian Company, which was advised by Mr. Beresford, a very well-known Indian engineer. Operations had been commenced at a good many sites, but it was necessary to proceed slowly with the work, otherwise a good deal of money might be thrown away in operations which were conducted on a wrong system. The company preferred to profit by the experience of one site before they took up another site; so that in that respect also the Government was doing something.

Mr. R. B. Buckley, C.S.I., said that the question of internal navigation in all countries was one which nowadays was attracting more and more attention, and the author had done good service in drawing attention to the necessity of improving the navigation of the Nile. The Chairman seemed to think that the cost of doing the work might be prohibitive, but other nations were spending very large sums indeed in works of a similar nature, and he therefore hoped Egypt would find the funds which were necessary for mproving her navigation. Egypt had, in one way, given great assistance to the navigation of the Nile by following the lead which other countries had adopted of removing all tolls from boats on navigable rivers. Many years ago in Egypt, when the Government constructed the bridge at Cairo, they put a toll on all boats going through the bridge, and the same system was adopted when a new canal with locks was opened. But the Egyptian Government, under its present enlightened rule, had entirely removed the tolls, and all the navigable canals and rivers were entirely free. He believed that France in the last 30 years had spent £70,000,000 sterling on improving the navigable waterways, which were entirely free of tolls. The American Government had spent nearly a million pounds in improving the navigable rivers which were connected with the great coal centres, and they were also entirely free from tolls. The only country, (as far as he knew, which still charged tolls on Government works was India; while in England the canals were in a state of chaos, under different administrations. The point he wished to emphasise was, that if France, Egypt, and Germany (which had spent 15 or 20 millions on improving her waterways) had free waterways, while in England and India tolls were charged on all the navigable routes, a very great injustice was done to the people of those countries, because they had to

pay more for the carriage of their goods to the seaboard than traders in countries which had free waterways. The only other point to which he wished to refer was the question of the amount of the discharge from the Victoria Nyanza into the Nile. It was stated towards the end of the paper that 45 per cent. of water on the Victoria Nyanza found its way into the Nile. He could not but think there must be some mistake in those figures. Three years ago he visited the Victoria Nyanza, inspected the four or five gauges on the lake, and criticised all the data concerning them. The author gave the rainfall alone on the Victoria Nyanza as 50 inches; he did not think it was quite as much, but the facts were not very well known. The Nile carried, at the outside, from the Victoria Nyanza in the course of a year, an amount of water which might lower the lake nine to twelve inches, which was only equivalent to about one-fifth of the rainfall on the lake. But the rainfall was not all the water that came into the Victoria Nyanza, because about 75 thousand square miles of land round about drained into the lake, so that the proportion of water which actually flowed out of Jinja was considerably less than one-fifth or one-sixth of the water which went into Lake Nyanza. He mentioned the question because the fact was interesting in this connection. There were some present besides himself who could remember when Speke and Grant discovered the Ripon falls close to Jinja. Since then great developments had taken place in Egypt, and one idea which at first sight appealed to one strongly was that the Victoria Nyanza would make an excellent reservoir from which to feed all the lands which required irrigation down the Nile. But when the question was thoroughly examined, the conclusion was arrived at that the amount of water which went out of Jinja on the Ripon falls would be practically powerless in having any effect on the amount of water available for the Nile. The fact was that the water of the Victoria Nyanza did not go into the Nile; it flowed down and all round the Nile, and then came back again; it was constantly passing into the lake and up again by evaporation, so that the great lake, important and interesting as it was, would never serve any great purpose in adding to the summer supply of the Nile.

Mr. ALEXANDER ROGERS said a good deal was written in the newspapers about the obstruction of the Nile caused by sudd. He thought it would be of interest if the author would explain what sudd was, in what part of the river it occurred, and if anything had been done to free the channel from obstruction.

Sir WILLIAM PREECE, in reply, said that the River Nile, from Bor to the White Nile through the marshes, was blocked in many places by sudd, which was composed of papyrus and other reeds, swimming plants of innumerable kinds, a tree that grew with great rapidity, root and branch practically, in the water, called "buzz," and another tree, the Arab name of which was "mother of cotton." Those things grew in one impenetrable mass across the river, blocking it and preventing navigation. The sudd was so dense that it held up the water just as a dam would do. Between Bor and the White Nile there were fifteen or sixteen such obstacles, many of them whose thickness could be measured in metres, many one and two kilometres, one 12 kilometres, and another 36 kilometres. They were from one to two metres deep, going right down to the bottom of the river, and were thus living vegetable dams. But the obstruction had been removed through the skill of an officer of the Royal Engineers. The sudd had been cut into solid blocks, which had been allowed to float down the river, and had disappeared before reaching Aswân. Sudd had been a great difficulty in the past, but it had been entirely removed. He believed the 36 kilometre sudd dam was removed last winter, and that the river was now clear of navigation all the way down to Gondokoro.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author for his extremely interesting paper, and the meeting terminated.

THE VILLAGE HOUSING PROBLEM.

In the *Journal* of January 17 mention was made of the Humphrey iron cottages as suitable for the purpose of rural housing, and the chairman of Humphreys Limited has been good enough to furnish some particulars. These iron cottages are for various purposes, from shooting boxes in Scotland to bungalows in the Transvaal; but here attention is confined to cottages erected in villages for the use of labourers. Many hundreds of these cottages have been erected in various parts of England, and many more would have been erected but for crippling by-laws. Of course there are many parts of rural England where there are no building by-laws, where a man may build the thing he will so far as any local authority is concerned. But more and more the district councils seem to be invested with urban powers, and the powers asked for are certain to include the right to make by-laws insisting upon "external and party walls of good bricks, stone, or other hard and incombustible material," instead of stud and plaster, or stud and galvanised iron. Herein is the difficulty, the crux of the village housing question. An excellent corrugated iron cottage, ample in size for the requisites of an ordinary village family, can be put up for £150, or less, but the local authority vetoes it. The cottage must be of "brick, stone, or other incombustible material." But why should a wood and galvanised iron cottage, standing on brick footings, on a concreted site, and matchboarded inside, be considered combustible, or more combustible than a

cottage of brick or stone? Why should the local authority object to corrugated iron when a peasant's cottage is in question, and raise no objection to it when a small-pox hospital has to be built? It is possible to put up such buildings for hospitals and asylums because they are exempted from the operation of the building by-laws, and it is noteworthy that over a million sterling has recently been expended by the London County Council, and other local authorities, upon similar buildings.

It is hard to understand how this fire bogey can be relied upon to justify the prohibition of iron cottages. The Chairman of Humphrey's, Limited, says that he can recall no single instance of a wood and iron cottage put up in a village by his company being burnt down, nor could better evidence of the groundlessness of the fear of fire be required then the fact that insurance companies will insure these cottages at 1s. 6d. per £100. The general adoption of the iron cottage would go far to solve the village housing problem. They are cheap, they are durable, and they are comfortable. First as to price. The £150 named above is the maximum. A good cottage of this kind can be put up for £130, but the rent a labourer can afford to pay will give a fair return upon an outlay of £150. Standing on brick footings the cottage should be a single story building, two feet above the ground. The single story lessens cost, saves the housewife much labour, and is healthier. The interior of the rooms being matchboarded, stained, and varnished, there is great cleanliness, as the housewife has only to use a duster of flannel and soap to keep them perfectly clean and wholesome, which cannot be said of cheaply papered or plastered walls. No doubt the building may be over hot in summer if not constructed by an experienced builder, but when an air space between the boarding, felt, and iron is provided for, it should be of an agreeable temperature all the year round. The durability of the iron cottages is very great. In towns the iron rusts, and its life cannot be put at more than twenty years, but in the purer air of the country it is practically indestructible. The allegation that the iron cottages are insanitary has no substance in it. What is there in iron, or varnished boarding, to make them insanitary. The earth closets in the outhouses used with this class of building are much preferable to the usually neglected "privies" left uninterfered with by the Local Authority.

Of course it is not suggested that resort should be had to iron and wood cottages and nothing else. But where, as in the immense majority of cases, new cottages will never be erected unless they can be put up so as to give 4 or 5 per cent. upon the capital outlay, these iron cottages, which can be erected at a cost to give this return, have much to recommend them. It may be hoped that before long means may be found to induce councils to abrogate, or amend, their building by-laws, but, meantime, it is well to remember that an iron and wood building—say a Humphrey's cottage—may be brought within existing by-laws by building a very small part in brickwork that does not add more than 15 per cent. to the cost of the building.

AGRICULTURAL EDUCATION IN CANADA.

Nothing is more remarkable in connection with Colonial development than the way in which the farmers of the Dominion, judiciously assisted by the State and Central Governments, have supported and benefited by agricultural education. Twenty years ago Ontario farmers were in a bad way. Their farms were mortgaged, their lands, owing to bad cropping, were losing their fertility and value, their sons were flocking to the professions, or the United States. Then the Hon. John Dryden became Minister of Agriculture for Ontario, and to him is chiefly due the happy reversal of circumstances in which the farmers of the province find themselves to-day. When Mr. Dryden first became Minister the quality of Canadian cheese and butter was very inferior. He set to work to improve, and, helped by the Government at Ottawa, Canadian dairy produce soon became famous for quality. In the report of the Bureau of Industries for 1889, the opinions of representative Ontario farmers are quoted to show that the Ontario hog raiser could never hope to compete on equal terms against the cheap pig food of the United States. At that time the old idea of a short, fat hog was still in the ascendant, and it was no wonder that the capture of the English bacon market was looked upon as impossible. During the early and middle nineties Mr. Dryden took personally in hand a campaign for improving the quality of the dairy and hog products of the province. He started what was known as the "Travelling Dairy," and kept it going from 1891 to 1898. It made annual tours through the country, and was laughed at as "Dryden's Circus." But it did what it was intended to do. It attracted attention, and thousands of farmers and their wives were taught what may be called scientific dairying. And concurrently the dairymen's associations grew to be powerful organisations for the promotion of new methods. The Government helped with money grants, the securing of good speakers, and the distribution of the reports of the meetings to 30,000 farmers. Two new dairy schools were also opened at Guelph and Strathruy, and that at Kingston was taken over. Since 1903, over 90,000 dols. has been spent in the education of over 2,200 dairy experts. During the last year the work has been extended to include a more minute inspection of factory and farm dairy premises in a way which insures the highest cleanliness, and best quality of cheese and butter.

Nor was improvement confined to dairy products. The hog was taken in hand. Mr. Dryden, backed by the Government, was determined to get a share of

the English market for Canadian bacon, and that was only possible by evolution in the hog. The provincial winter fair, the farmers' institutes, and the distribution of reports and bulletins, was the chosen medium The winter fair was made a fixture in Guelph, permanent buildings were erected, and prizes offered which would tempt the best breeders in the country. This attracted many thousands of the farmers. The pork packers were invited to attend, and by demonstration to tell the crowded audience of the lecture-room just the kind of hogs they wanted. They eagerly acccepted, the farmers' institutes' delegates attended and sized the "points" of a good hog, and how it could be produced by breeding and feeding, and they carried the message to numberless homes. The result was seen in a few years in the supplanting of the short, fat hog by the long lean ones, just the kind that make the streaked bacon and the red, sweet hams suitable to the English market. The remarkable success of this missionary work is shown by the increase in the value of the hogs sold by Ontario farmers from 8,775,852 dols in 1892 to 22,532,892 dols. in 1903.

Doing a work of this class, and yet fitting into the whole general scheme, the farmers' and women's institutes have accomplished much in the uplifting of agriculture. From a record of twelve meetings in 1885 the farmers' institutes have grown, says the *Toronto Globe*, from which many of these particulars are taken, to 837 meetings last year, with an attendance of 126,352, while the women's institutes, established three or four years ago, had last year 960 meetings and an attendance of 44,698. Skilled agriculturists, breeders, and home makers give the lectures at these meetings. Their addresses are the statements of men and women who have derived their knowledge from experience, and in imparting it they give the impression that what they have done others can do. The success of the Ontario live stock competitions at the Pan-American Exposition at Buffalo in 1901 was the best tribute that could be paid to the quality of the stock raised, and the triumphs at St. Louis last year are still fresh in the public recollection.

The improvements effected in the butter, cheese, and bacon products of Ontario are a striking illustration of what can be accomplished by co-operative effort, aided and guided by Governmental supervision. The Eastern Ontario dairymen have just concluded at Brockville their 20th Convention, and the papers and discussions showed the thoroughly scientific and practical methods that have been introduced in every department, from the care and milking of cows to the final shipment and disposal of the butter and cheese. The farmer no longer despises or mistrusts the scientists in the agricultural college or dairy school, but is keen to avail himself of the latest discoveries of scientific research. The statistics of decennial periods show that the output of creameries and cheese factories in the whole of the Dominion increased from 10,697,879 dols. in 1890 to 29 462,402 dols. in 1900. These figures show an increase in ten years of 18,764,523 dols. In 1890 there were 1,565 cheese factories and 170 creameries in Canada. In 1900 there were 2 398 cheese factories and 629 creameries, with 974 combination cheese and butter factories. The conventions periodically held tend to correct any faults that may show themselves, either in the scientific or commercial management of creameries and cheese factories. The best judgment of practical experience and scienti c inquiry is brought to bear on every problem. Every defect is fully ventilated and traced to its immediate and remote causes.

Something is being done in England in these directions, but how little as compared with what is being accomplished in Canada and elsewhere in Greater Britain! And yet it should be much easier to convey the necessary instruction here than in the sparsely-populated provinces of the Dominion. Nor is the need less.

STRAND IMPROVEMENTS.

The following address o the London County Council deals with a subject referred to in the paper on "Street Architecture," read before the Applied Art Section, by Mr. T. G. Jackson, R.A., on 20th December last.

"We, the undersigned, are anxious that the improvement of the Strand should be carried out in a manner worthy of so great an opportunity.

We desire to express our opinion that the frontage line now proposed by the London County Council will have a bad perspective effect, and we trust it may not be too late for the Council to adopt some plan showing better consideration for the position of the churches of St. Mary-le-Strand and St. Clement Danes.

We desire also to protest against the height of the buildings already begun, and to express our hope that on the rest of the frontage the new buildings may not be so lofty as to overpower the two churches and Somerset-house, which are and should remain the principal ornaments of the Strand.

EDWARD J. POYNTER.	G. F. BODLEY.
HAMO THORNYCROFT.	WM. F. YEAMES.
T. G. JACKSON.	FRED. A. EATON.
L. ALMA TADEMA.	R. NORMAN SHAW.
ERNEST CROFTS.	THOS. BROCK.
ASTON WEBB.	ERNEST NEWTON.
ERNEST A. WATERLOW.	JOHN BELCHER.
W. B. RICHMOND.	BERESFORD PITE.
GEORGE FRAMPTON.	BASIL CHAMPNEYS.
H. H. ARMSTEAD.	REGD. BLOMFIELD.
G. H. BOUGHTON.	HENRY T. HARE.
ROBERT W. MACBETH.	C. F. A. VOYSEY.
J. W. WATERHOUSE.	WALTER CRANE.
MARCUS STONE.	MARK H. JUDGE.

Mr. Jackson sent this address for publication in *The Times* with the following letter to the Editor:—

Sir,—A copy of an address intended to be presented to the London County Council on this subject was sent you the other day for publication without the leave or knowledge of those responsible for it, who would not have been guilty of the discourtesy of publishing it before it had been seen by those to whom it was addressed.

It has now been received by the London County Council, and is under consideration, and I therefore beg to send you a copy with the names of the signatories correctly given, which was not the case in the unauthorised copy sent you before.

The plan now recommended by the Improvements Committee for the new frontage is, as I said in a former letter, the cheapest and worst that has been submitted to the Council. It is laid down on purely economical and utilitarian lines, and the report with which the committee have accompanied their recommendation scouts the idea of attaching any importance to æsthetic considerations. This, I trust, will not be the attitude of the Council as a whole. They have on former occasions listened favourably to representations of an æsthetic character made by persons who from training and habit were justified in speaking with authority. The church of St. Mary-le-Strand, which was condemned to be destroyed, was spared when its value as a work of art was explained. We trust that the present appeal from a large number of artists, among whom will be found most of those who have a claim to be heard on such a subject, will be equally successful.

That art is always to give way to economy when it comes to a question between them will hardly be maintained by the most advanced utilitarians. Were it so, surely we had better confess ourselves at once an inartistic people, shut up our art schools, and save the many hundreds of thousands of pounds we spend in preaching and teaching what in our practice we treat as valueless. Art must be paid for, and cannot be had without some sacrifice; and, if ever a sacrifice were worth while, surely it is so now, if it will save the fine buildings in the Strand from being smothered by monstrous edifices like that next the Gaiety Theatre, which would reduce them to the scale of toys and the Strand to the awful gloom of Victoria-street and the sombre melancholy of Northumberland-avenue.—I am, Sir, your obedient servant,

THOS. G. JACKSON.

Eagle-house, Wimbledon.

OBITUARY.

SIR JOHN NEILSON CUTHBERTSON, LL.D., J P.—Sir John Cuthbertson died on the 26th January at his residence in Glasgow. He was born in 1829, and educated at the High School and University of Glasgow, also at the Royal College, Versailles. He was knighted in 1887, and received the degree of LL.D. from the University of Glasgow in 1895. He was a chemical and produce broker, and one of the best-known public men in Glasgow and the West of Scotland. For 25 years he was a member of the Glasgow School Board, and for 15 of these was the chairman. He was a member of the University Court, Glasgow, and a governor of the Glasgow and West of Scotland Technical College. Sir John Cuthbertson was elected a member of the Society of Arts in 1894.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

FEBRUARY 8.—"Time Development in Photography, and Modern Mechanical Methods of carrying it out." By R. CHILD BAYLEY. GEORGE DAVISON will preside.

FEBRUARY 15.—"The Decline of the Country Town." By ARTHUR HENRY ANDERSON.

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual*—due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials." By MARION H. SPIELMANN, F.S.A. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

JAMES P. MAGINNIS, Assoc.M.Inst.C.E., M.Inst.Mech.E., "Reservoir, Stylographic and Fountain Pens." Three Lectures.

LECTURE III.—FEBRUARY 6.—*Fountain Pens.*—Early patents—Solid ink—Various reed arrangements — Self-filling reservoirs, flexible reservoirs, piston and plunger—Modern types of Fountain pens, Swan, Ideal, Conklin, Pelican, Unleakable, Wirt, Quill, Post, Autofiller, Fleet, &c.

DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Four Lectures.

LECTURE I.—FEBRUARY 13.—*Fundamental Principles.*—Internal combustion engines are essentially air engines—Thermodynamics of air engines—Two types, constant volume and constant pressure—Theory of compression—Efficiencies without heat or other losses—Gaseous explosions—Temperature measurements—Bunsen's method—Efficiencies with heat and other losses—Coal gas, petrol, alcohol and producer gas explosions: their differences and similarities.—Data still required.

LECTURE II.—FEBRUARY 20.—*Indicator Diagrams and Power Tests*—Diagrams from engines using coal gas, producer gas, blast furnace gas, petrol and heavy oils—Practical efficiencies and limitations in large and small motors for constant volume and constant pressure engines—Brake tests—Irregularities in diagrams, pre-ignitions, back ignitions, exhaust explosions, missed ignitions.

LECTURE III.—FEBRUARY 27.—*Examples of Internal Combustion Engines in Britain.*—Coal gas and producer gas engines, Crossley, National, Stockport—Blast furnace gas engines, Cockerill, Koerting, Crossley, National—Petrol engines, Wolsley, Liddeley, Daimler—Heavy oil engines, Deisel, Hornsby, National, Crossley.

LECTURE IV.—MARCH 6.—*Future Developments* — Suction producers — Blast furnace gas—Producer gas in power-stations—Marine gas and oil engines—Line of advance.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. James P. Maginnis, "Reservoir, Stylographic, and Fountain Pens." (Lecture III.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Inaugural Address by the President, Mr. Nicholas J. West.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. W. P. Dreaper, "The Theory of Dyeing. Part. II.—Pseudo-solution and Desolution." 2. Mr. J. W. Lovibond, "The Fading of Inks and Pigments."

British Architects, 9, Conduit-street, W., 8 p.m. President's Address to Students.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. 1. Rev. J. Bradford Whiting, "The Growth of the Kingdom of God." 2. Rev. John Tuckwell, "Religion and Science."

London Institution, Finsbury-circus, E.C., 5 p.m., Mr. M. H. Spielmann, "The Wallace Collection."

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. Pascal Needham, "The Development of Song Writing."

TUESDAY, FEB. 7...Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Structure and Life of Animals." (Lecture IV.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

National Service League, Caxton-hall, Westminster, S.W., 5½ p.m. Lieut.-Col. O. T. Duke, "The Physical Advantages of Universal Naval and Military Training."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Lyonel Edwin Clark's paper, "Floating Docks." 2. Mr. E. F. C. Trench, "Alfreton Second Tunnel." 3. Mr. Dugald McLellan, "The Reconstruction of Moncrieffe Tunnel,"

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, FEB. 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. R. Child Bayley, "Time Development in Photography, and Modern Mechanical Methods of carrying it out."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, FEB. 9..Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. Canon Benham, "The Literary History of the Bible."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Schlich, "Forestry in the British Empire." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on paper by Messrs. W. H. Booth and J. B. C. Kershaw, "Fuel Economy in Steam Power Plants." 2. Mr. G. L. Addenbrooke, "The Value of Overhead Mains for Electric Distribution in the United Kingdom."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Col. Sir Howard Vincent, "The United States Army of To-day."

FRIDAY, FEB. 10...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Mr. Cecil Smith, "The Art of the Ionian Greeks."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. P. J. Risdon, "The Reconstruction of the Santa Lucia River Bridge, Uruguay."

Astronomical, Burlington-house, 5 p.m. Annual Meeting.

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. C. S. Spooner, "Church Fittings."

Clinical, 20, Hanover-square, W., 8½ p.m.

SATURDAY, FEB. 11...Royal Institution, Albemarle-street, W., 3 p.m. Sir Alexander Mackenzie, "The Bohemian School of Music." (Lecture II.)

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FRIDAY, FEBRUARY 10, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 13, 8 p.m. (Cantor Lecture.) DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Lecture I.

WEDNESDAY, FEBRUARY 15, 8 p.m. (Ordinary Meeting.) ARTHUR HENRY ANDERSON, "The Decline of the Country Town."

THURSDAY, FEBRUARY 16, 4.30 p.m. (Indian Section.) SIR CHARLES A. ELLIOTT, K.C.S.I., "The Indian Census of 1901."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 6th inst., Mr. JAMES P. MAGINNIS delivered the third and last lecture of his course on "Reservoir, Stylographic, and Fountain Pens."

A vote of thanks to the lecturer was passed on the motion of the Chairman.

The lectures will be published in the *Journal* during the summer recess.

MAP OF THE NILE.

With this number of the *Journal* is issued, as a supplement, a map illustrating Sir William Preece's paper on the "Navigation of the Nile," published in the last number. (See *ante*, p. 274.)

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday, January 24, 1905; Sir EDWARD A. SASSOON, Bart., M.P., in the chair.

The paper read was—

BRITISH COMMERCIAL PROSPECTS IN THE FAR EAST.

BY BYRON BRENAN, C.M.G.,
Late H.B.M. Consul-General at Shanghai.

The subject of my paper is "British Commercial Prospects in the Far East." This covers an enormous field, and in the time at my disposal it would be impossible to do more than treat very superficially a variety of questions, with the result that at the end of my address my audience would only carry away a very confused mass of ill-assorted information. It will, therefore, be better, I think, to confine my remarks to China, which, after all, is quite large enough to occupy our attention for one afternoon, and is also a portion of the map of Asia, where I feel on firmer ground than in the neighbouring countries.

In order that you may be able to follow what I am going to say, I shall begin by explaining the conditions under which British subjects and foreigners generally may now engage in business in China. By the word "foreigners," which I shall use frequently, I mean non-Chinese subjects of all nationalities.

THE PRESENT SITUATION.

In virtue of various treaties, foreigners may reside permanently in certain towns and places. These are officially called "Treaty ports," but as some of the more recently opened places are in the interior, and remote from navigable waterways, they can scarcely be

called ports. The names of some will be quite familiar to you: Shanghai, Canton, Hankow, Tientsin, for example. Of these places, there are eleven on the sea-board, fourteen on navigable rivers, and a few inland. At all these places foreigners may establish themselves in business, and import or export merchandise on payment of a certain duty fixed by convention, and it is important to remember that Chinese subjects at these Treaty ports are put on the same footing as regards the payment of duties and the distribution of goods as the subjects of foreign powers, the principle being recognised that the tariff applies not to the merchant but to the merchandise.

On first thoughts it might seem that the more there are of these places the better; that if we could plant our merchants all over the country it would be a great advantage. But this is not so. In practice it is found that new Treaty ports do not attract the foreign merchant, and for the adequate reason that there is no money to be made by settling there. The simple explanation is that, for all business purposes at all the Treaty ports, the Chinese merchant has all the advantages of the fixed tariff charges which have been secured by the foreigner, and can carry on the business of buying and selling at less expense than his European rival. The tendency is becoming more and more for the Chinese, who are the distributors of imports from foreign countries, and the collectors of native produce intended for exportation to foreign countries, to buy and sell at one of the few great *entrepôts*, of which Shanghai is the chief.

Too much is made of the opening of new ports. Some of the more recently opened Treaty ports have never been visited by a foreign merchant. The history of their opening is usually this. Something unpleasant has happened in China, and there is a storm of indignation in England. We don't see our way to enforcing proper satisfaction, so, somewhat on the principle, I suppose, of any port in a storm, we demand the opening of one or more ports. The Chinese Government are shrewd enough to know that what is easily obtained is not much valued, so they set up one objection after another for us to demolish, and when they think we have forgotten all about the original cause of quarrel, they consent to open a port, and then port and all is forgotten. As an example, a thick Blue-book of the year 1899 concludes with two telegrams—the first from the British Minister in Peking, reporting that the port of Nanning, in the Kwangsi province, has been declared open by Imperial decree; and the second from the Secretary of State for Foreign Affairs, sending his congratulations on the result, which he considers very satisfactory. Well, nobody has been near Nanning since. In 1897 I made a report to the Foreign Office, in which I called attention to the small number of British firms then existing in China. There were eighty in Shanghai, and fifty-three more were distributed among eleven other ports. Six ports had none at all. Since then I do not think the figures have changed much, except that some half-a-dozen more ports have been opened without attracting any British merchants.

In spite of the opening of new ports, the tendency is for foreign merchants to concentrate at the principal places, and, as I have said, to leave to the native dealer the work of distributing foreign merchandise and of collecting native produce; and so I think it will continue to be, no matter how much the country may be thrown open to the foreigner, how greatly the means of transportation may be improved, or how many new markets may be discovered. Nor need this prospect be viewed with regret. As a nation we are chiefly interested in the volume of trade; the prosperity of the British merchant established in China is a matter more of individual than of national concern.

That the volume of trade is not as large as under more favourable conditions it could be is evident. Japan, with a population of one-sixth, spends almost as much as China on foreign goods. India, with a smaller population, has a foreign trade more than twice as large as China; and yet, as trader, artisan, or agriculturist, the Chinaman can give the other two a long start and beat them. What then is the explanation? It is mainly that the Chinese Government does not give a thought to such matters as the expansion of commerce, or the development of the resources of the country; and, furthermore, without considering the direct or indirect consequences of its action, it will, in the pursuit of some local, temporary, and insignificant gain, blindly adopt measures which end in strangling trade and killing enterprise. Such progress as we may notice has been made in spite of, and not in consequence of, Chinese official action. Our own statesmen do not seem able to agree as to what is the best fiscal policy to adopt, but there is one point on which there would be no

difference of opinion, and that is that China's fiscal policy is wantonly suicidal.

Of the fiscal errors committed by China's rulers I could give you a long string of examples. One will enable you to judge of their manner of looking at things. When a new Commercial Treaty between China and this country was being negotiated a couple of years ago, we on our side claimed that any import duty put upon British manufactures should be balanced by an equal duty or excise on Chinese manufactures of a similar nature. From another quarter came a suggestion that some preference should be shown to native industries. This was strenuously opposed by Chang Chih Tung, one of the Chinese negotiators, and one of China's foremost and most influential officials. Far from desiring to give encouragement to the Chinese production of foreign things, he was disposed to render Chinese competition impossible, and why? Because if China could manufacture any foreign article for herself she would cease to import it, and then China would lose the import duty. This narrow view, that the chief function of trade is to bring in revenue to the Imperial exchequer, seems to possess Chinese officials and their foreign advisers alike. Any facility given to commerce is looked on as a dangerous innovation, as a generous concession, and as a relaxation of some necessary restriction which must be well paid for.

When that good time comes that China, in proportion to her population, has as large a foreign trade as Japan, here are a few of the improvements we may see. Of cotton tissues, China will import nearly three times as much as she does now; of woollen goods, nineteen times as much; of iron, steel, and other metals, six times as much; of machinery, twenty-six times as much; of electrical materials and fittings, three times as much; and so on for many other articles.

Our chief hope in the future must rest not on our Government obtaining for British subjects more facilities or so-called privileges than they already enjoy under existing treaties, but rather in utilising every opportunity that presents itself for inducing the Chinese Government to give its own subjects a fair chance by granting them full liberty to improve their position and grow rich. The people of China within their limits are free spenders of money; what in our own interest we should wish to see is that they should have more money to spend. British commercial prospects in China are intimately connected with the development of China's material resources, and whatever we can do towards removing the difficulties that beset the industrious classes in that country will be a service which will be repaid to us with interest.

RAILWAYS.

It is in the construction of railways and in the opening of mines that the profitable employment of capital might be looked for, and I propose to give my idea of what are our prospects in this direction.

When the map of China is looked at, the thought at once arises that millions upon millions of British money might be profitably invested in the construction and equipment of railways alone, but as one comes to closer quarters with the question one realises that the prospect is not so alluring. The building of railways has but recently begun, and, to judge from the start that has been made, it looks as if it was the desire of the Chinese Government that the railways of the country should be a State enterprise.

Speaking in a loose sort of way, certain foreign syndicates are said to have obtained railway concessions. This is somewhat misleading. With the exceptions I shall mention presently, all the agreements for the construction of railways which have been signed so far are drawn up on much the same plan. When the Chinese Government has decided that a certain line may be constructed, a foreign syndicate makes an estimate of the cost, and the Government authorises the syndicate to place a Chinese Loan on the foreign market for the necessary amount. The usual terms are that the Chinese Government shall receive £90 net for each £100 bond; the rate of interest is 5 per cent., and the security is the earnings of the railway, and, in default of these, the revenues of the Empire. As a guarantee that the money shall really be spent in building the line, the construction is entrusted to the syndicate interested, and the control of the accounts is also largely left to it, and after the line has been completed, the syndicate, as trustee for the bondholders, is given a preponderant voice in the upkeep and running of the railway. The Chinese Government reserves the right to redeem the bonds in a certain number of years, and when the loan has been completely paid off, the railway is to become the absolute property of the Chinese Government. The holder of a Railway Loan Bond is thus in the position of a preference shareholder, and all that the syndicate gets

out of the business is such profit as it can make in floating the loan, a commission on the purchase of materials, and a share amounting to one-fifth of the net earnings of the line after the interest on the loan has been paid.

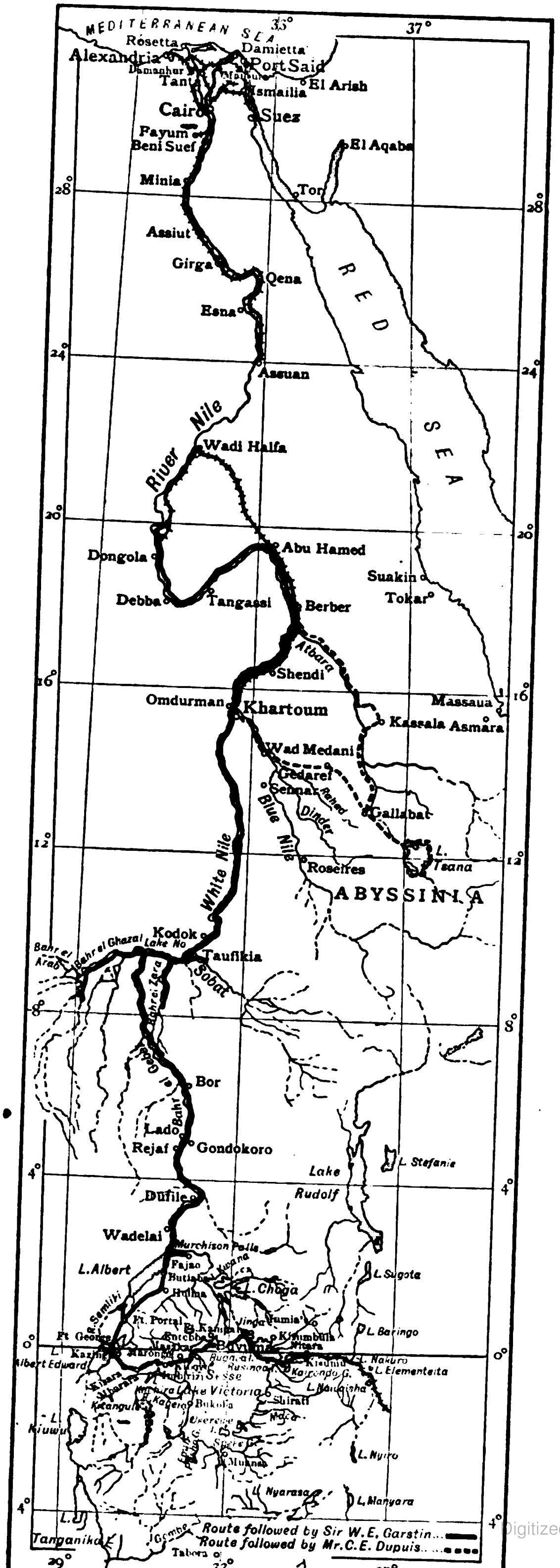
Having begun in this way, it is probable that these are the best terms which the Chinese Government will be willing to give when any more railways are applied for by foreigners. Indeed, it is to be feared that an attempt will be made to reserve to the Chinese a greater share of the control, and that to this extent the security of the bondholders will be impaired. With the experience they have gained in the railways already under construction, the Chinese have come to think that their authority and their interests are too little considered, and in future cases they may seek to remove the defects which they see in the earlier contracts. The credit of the Chinese Government is not so good that the British bondholder can afford to look to that except as a forlorn hope. If he is a wise man, it is to the railway and its earnings that he must look for the payment of his interest and the eventual return of his capital. No matter what the earning powers of a railway might be, it is absolutely certain that under purely Chinese management the upkeep of the line would be neglected, and the earnings would be swallowed up by a numerous staff composed of the friends and relations of the Board of directors. It is absolutely essential that those with whose money a railway is built must be in a position to prevent waste and mismanagement. Unless this can be guaranteed, foreign capital will not be obtained from those quarters where railway construction is looked upon honestly and simply as a financial investment. There may, of course, be cases where the security of the 5 per cent. interest is a minor consideration, and where, for political reasons, means may be found of providing the requisite amount on China's own terms. It is here that the British capitalist is at a disadvantage. Without pretending to be behind the scenes as to the ways of other Governments, I am convinced that our Foreign Office will never consent to infuse confidence in the British capitalist by hinting that they will see that he comes out all right in the end if he will but secure some sort of a contract now.

At present the interest on the bonds is coming out of capital, so it is too soon to know how these contracts will work out in the long run. Once a line is completed, however, such interest has to come out of the earnings. It is quite possible that before long the Chinese Government will be called upon to make good a deficiency in this respect, and it will then take alarm, and be shy about guaranteeing any more loans. Indeed, already the Chinese are representing that it is unjust for foreigners to press them to borrow money for the construction of railways which the foreigners themselves do not feel confident will earn 5 per cent. If the importunate foreigner is sure the line will pay 5 per cent., they say, why insist upon a Government guarantee? And if he is not sure about it, why put pressure on China to authorise the construction? An awkward question to answer, certainly, and the best answer we have discovered so far is that, as others are doing this, so must we.

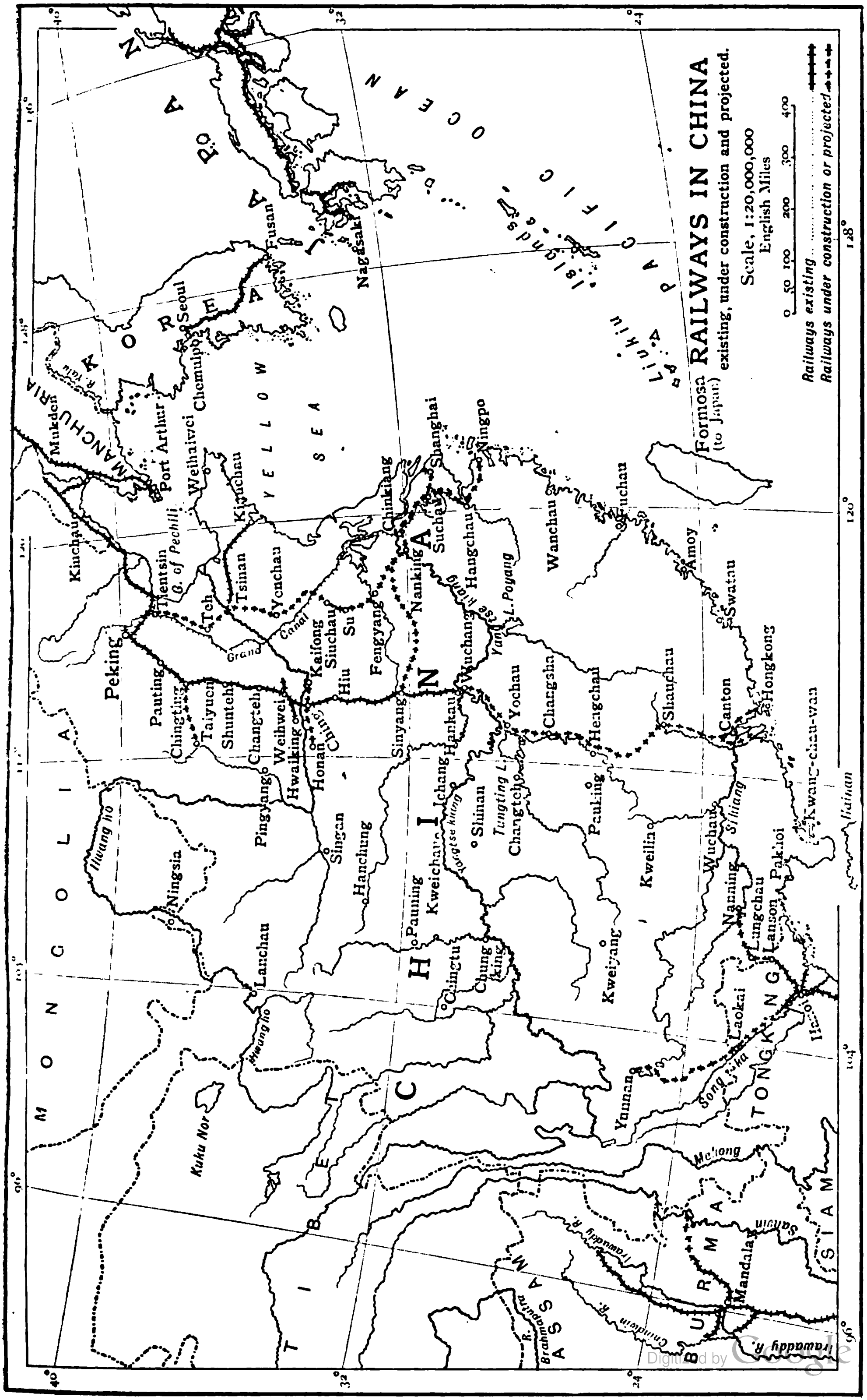
It is a mistake to suppose that the rulers of China are persuaded that they must have railways, and that as China cannot finance them they must have recourse to the foreigner, and make the best terms they can with him. Many enlightened Chinese do see the advantage of railways, but it is not with these that the decision rests. Those who have the final say in the matter care little whether railways are built or not. They have but a dim idea what prosperity attends improved means of communication; moreover, a desire for the welfare of their country is only felt in an abstract sort of way as a good theme for an examination essay, but it does not form part with them of what is called practical politics. What they do realise is that foreign railway concessions are liable to involve them in worries and land them in difficulties, and that on the whole it is best to leave well alone.

The English capitalist will go the wrong way to work if he begins his negotiations in the spirit of the man who holds the purse strings and can command his own terms, and who thinks it an unanswerable argument that unless certain conditions are granted it will be impossible to float a loan. This may, indeed, be the case, and may be very convincing to the would-be contractor, but it does not convince the Chinese negotiator, who, be it remembered, is not particularly anxious to be convinced.

Now I come on ground where I must proceed warily. It is not only British financiers and concession-seekers who wish to place their services at the disposal of the Chinese Government. There are others, and the Chinese, both in politics and in business, have ever been expert at setting one nationality against another. It is pretty certain that



Emery Walker sc.


RAILWAYS IN CHINA
existing, under construction and projected.
Scale, 1:20,000,000
English Miles
0 50 100 200 300 400
Railways existing
Railways under construction or projected
PACIFIC OCEAN
JAPAN
KOREA
YELLOW SEA
MANCHURIA
MONGOLIA
TIBET
CHINA
TONGKING
BURMA
SIAM
ASSAM
Formosa
(to Japan)
Liukiu Islands
Peking
Tientsin
Port Arthur
Mukden
Seoul
Chemulpo
Fusan
Nagasaki
Weihaiwei
Kiauchau
Tsinan
Shanghai
Ningpo
Hangchau
Suchau
Nanking
Chinkiang
Hankau
Wuchang
Yochau
Changsha
Hengchau
Canton
Hongkong
Kwang-chau-wan
Amoy
Swatau
Fuchau
Wanchau
Kaifong
Honan
Singan
Lanchau
Ningsia
Chingtu
Chungking
Kweiyang
Kweilin
Yunnan
Laokai
Lungchau
Lanson
Nanning
Wuchau
Pakhoi
Mandalay
Kuku Nor
Pauting
Taiyuen
Ichang
Shasi
Sinyang
Fengyang
Grand Canal
L. Poyang
Tungting L.
Hainan

every draft contract and every estimate which is submitted to the Chinese is picked to pieces and misrepresented by jealous competitors and by political opponents. The jealous competitor will offer to do the same thing on better terms, and the political opponent will fill the suspicious Chinese officials with nervous apprehension; for to spoil another's concession is almost as sweet as securing one for oneself. As we say in private conversation, I will not mention names, but I have known the representative of one foreign Government, who had a railway under his protection, threaten to demand heavy damages from the Chinese if they permitted the construction of a certain line which another syndicate was trying to obtain, his disingenuous pretext being that it might become a competitor, and this proved sufficient to spoil the business.

When one party is trying to secure the financing and construction of a line, and offers terms which are in every way fair and reasonable, it makes his position very difficult if another person, especially of a different nationality, is underbidding him, or, at any rate, offering terms which may on the surface seem to be less onerous; and I need hardly say that when an agreement is being discussed for the construction of a railway, the only specification being that it shall extend from this town to that, it by no means follows that the lowest estimate will turn out to be the cheapest. To a large extent the Chinese have to take your word for it what things cost, and how much is expended on construction as the work proceeds; so, with the spending of the money and the preparation of the accounts left entirely to him, you can conceive how a man who is well equipped with mental reservations may be willing to undertake the task on very low terms, and to find the money as low even as 4 per cent.; and here I must leave you to draw your own inferences.

It is an open question when constructing a railway tentatively in a new country whether it is the better plan to make a first-rate job of it from the beginning, regardless of cost, so that no expenditure on repairs or improvements will be required for years, or whether to build as cheaply as possible by beginning with a single line, using light rails, and erecting wooden bridges and temporary stations, and thus put off the heavy expenditure necessary to convert it into a first-class line until this can be done out of the earnings of the line itself, or until the fact that the line is earning profits makes it possible to raise money on cheaper terms. Whichever may be the soundest policy from the financial point of view, I am inclined to think that the person who proposes the cheap and gradual method has the best chance of getting the business from the Chinese. They have no experience of railway finance, and it is Chinese nature to prefer paying twice by-and-bye to paying once on the spot. To them the ideal railway would be the one that could grow out of its first ten miles, like a plant grows out of a small seed. Another consideration which will carry weight is this: that the constructor who spends a large part, and even an unprofitable part, of the available money in the purchase of Chinese materials, and, as it were, does not take the money out of the country, will be going a long way towards ingratiating himself with his Chinese employers. In pursuance of this policy, the Belgians, with an eye to future favours, are buying largely from the Government iron-works at Han-Yang for the line they are now constructing.

It is now time that I should tell what are the railways for which agreements exist on the terms I have indicated above. They are:

1. From Peking to Tientsin and Newchwang, with a branch from Kou-pan-tzu to Sin-min-tun.

This has been in operation for some years. It has been built partly with Chinese and partly with English money. Our control is consequently not quite so extensive as in the other railways, but sufficient to safeguard the interests of the British bondholders.

2. From Peking to Hankow. This is a Franco-Belgian undertaking, and it is completed all but a long bridge which will span the Yellow River.

3. From Kai-feng-fu to Ho-nan-fu. This is also a Franco-Belgian line. No work has yet been done.

4. From Cheng-ting-fu to Tai-yuan-fu. This is a Russian undertaking, and a beginning has been made.

5. Hankow to Canton. A certain amount of work has been done at the Canton end, where a branch line has been built as far as Samshui, but now there is a hitch. The Americans do not seem able to find the money, and they have transferred a large share of their interest to the Belgians. On this ground the Chinese are trying to cancel the agreement.

6. Shanghai to Nanking. This is a British enterprise, and the work was recently begun.

There are other railways for which preliminary agreements on the same basis exist, but the final agreements have yet to be negotiated,

and it is probable that no further steps will be taken until it is seen how the lines now under construction pay. These railways in embryo are:

1. From Soochow to Hangchow and Ningpo.

2. From Pukow, opposite Nanking, to Sin-Yang, where it will join the Peking-Hankow railway.

3. From Kowloon, opposite Hong-Kong, to Canton.

All these three are British undertakings.

4. From Tientsin to the Yangtze river, either at Chinkiang or Nanking. This is an Anglo-German interest.

In addition to the above there are other railways in the Chinese Empire, either completed or in course of construction, which are not Chinese State railways. These are:

1. The Manchurian Railways, from Port Arthur to Harbin. These have been built entirely with Russian money, and controlled by Russia. Their future status will probably be decided when terms of peace are arranged between Russia and Japan.

2. The Shantung Railways, from the German port of Tsingtao (Kiaochow) to Tsinan-fu, the capital of the province. This has been built with German money, and is German property.

3. From Ching-hua to Tao-kow, in the province of Honan. This is completed, and has been constructed by the Peking Syndicate (a British concern) with its own money, but there is a probability of its being taken over by the Chinese Government on the 5 per cent. loan plan.

4. From Macao to Samshui. A concession has been granted to a Portuguese-Chinese company.

5. From Langson, in Tongking, to Nanning, on the West River.

A French company has a concession for this, but no work has yet begun.

6. From Laokai to Yun-nan-fu, the capital of the province of Yunnan.

A concession for this has been granted to a French company under French Government control.

So far then, the English are only engaged in the construction of one railway—from Shanghai to Nanking. On the successful issue of this undertaking a great deal depends, for the Chinese will soon have the opportunity of judging which of the several foreign companies is serving them best. So far, everything is in our favour. To begin with, the Shanghai-Nanking Railway passes through the richest portion of China, and if railways are to be remunerative in any province, this railway has the best chance.

Then we ought to profit by the mistakes of others. I do not mean mistakes in construction or management, but mistakes in our attitude towards the people or the officials. What they do not like is a disposition to brush them aside when they seem to take an interest in the business, and they silently resent being ignored as the proprietors of the railway. What will tell in the long run is the reputation for good faith and fair dealing, or the reverse, which the different syndicates now engaged in railway construction establish for themselves. In the eagerness to secure immediate profits this fact is apt to be lost sight of. A shabby trick or a bit of sharp practice which may bring in an immediate thousand pounds will cost more than a hundred thousand in the hereafter.

The question whether the extension of railways will proceed on the plan on which they began—I mean the Government loan system—will depend on the financial success or the failure of the lines now building. If they prove a success, the 5 per cent. interest and contingent profits will probably appeal to investors in foreign countries, and, on its side, the Chinese Government will favour a method which brings them in a revenue and involves them in no responsibility. Should, however, the railways fail to pay their way, and the Government is called upon to make up a deficit, it will probably leave the extension of railways to those who are willing to take the risk.

Except in a few favoured localities, I do not think that at present foreign capitalists are prepared to construct railways on their own account, and merely rely on the earnings of the line for their reward, and I do not believe that the Chinese Government would view favourably any such schemes. It must not be forgotten that, in China neither foreign subjects nor their property are subject to Chinese law. This is the chief reason why foreigners and their operations are restricted to the open ports, where courts exist administering their own laws before which they can be called to account. Questions of all sorts in connection with a foreign-owned railway would arise in the interior, and there would be no means of obtaining redress. To conceive what confusion and complications would ensue, one must imagine the Midland Railway owned and managed by Frenchmen, and every time there

was a claim against the French company or its servants, the plaintiff was told he must go to Paris to seek redress; or, still worse, that no legislative enactment of our Board of Trade affecting the railway could be put in force without the consent of the French Government.

The Chinese Government has not the same reasons for objecting to railways being constructed by Chinese with Chinese capital, and there has been a good deal of talk of forming Chinese joint-stock companies; but I much question whether the money exists, or whether Chinese shareholders would have sufficient confidence in their directors, or could trust their officials to keep their hands off the earnings. Such a railway would be expected to render gratuitous service to the State, and when it comes to this sort of thing, there is a wonderful amount of travelling on Government account.

A danger to which capital invested in private railways will be exposed must not be overlooked. China is a country where rebellions are frequent, and it is the habit of insurgents while they have the upper hand to make a clean sweep of everything. In certain places within easy reach of assistance, foreign powers might take steps to protect a railway built with their people's money, but most parts of China are inaccessible to foreign ships or troops. If destruction on a large scale took place it would be difficult to obtain compensation. The national revenue of China is already deeply pledged for the payment of loans and indemnities due to foreign Powers, and it is doubtful whether more could be wrung out of the Government without having recourse to force. It is true that during the Boxer trouble the railways in the north were partially destroyed, and compensation was exacted, but the Chinese Government was held to be responsible for the damage, and, moreover, the occupation of the capital and the presence of a large number of foreign troops left the Chinese no alternative but to submit.

I must refrain as much as possible from touching upon politics, but closely connected with our future trade is the tendency of some Powers to mark off certain parts of China as their especial sphere of interest or influence. It may be permitted to hope that, as one outcome of the war now proceeding in the Far East, all tampering with the integrity of China will cease, and that some sort of Monroe doctrine will be proclaimed. The Chinese Government, left to itself, is willing to give to every country, I will not say a fair field and no favour, but, at any rate, some sort of a field and no favour; but a sphere of interest has a way of developing into a sphere of influence, and then into an exclusive preserve. The manner in which railways are being financed opens the way even now to preferential treatment. It is not much good having an impartial tariff of duties for all sorts of merchandise if the railway directors are able to counteract this by fixing arbitrary rates of freight, and it is not at all impossible that those who have the control of a railway could make it very unpleasant for any British enterprise which depended for its success on punctuality in transportation and on reasonable rates of freight. The fact that the control of railways will be left very much to companies of different nationalities, and in some cases to companies that must do the bidding of their protecting Governments, must cause some anxiety, and supplies a strong reason why it is desirable that the whole railway system of China should pass under one honest, impartial, and competent management, if such can be devised.

In order to make my meaning perfectly clear, I will imagine two possible cases. Two companies, one English and one French, have petroleum wells in the province of Ssuchuan, and the only exit is over a railway controlled by the same French company. Is it not easy to see what the result would be? Or take another case. A rich district is at the terminus of a railway under German management. At a certain town there is a junction with a British railway by which the coast can be more easily reached than by continuing the journey on the German railway. Would there not be a temptation to so arrange the through rates as to deprive the English railway of its legitimate share of business?

MINES.

It is in the exploitation of her mineral resources that one might look for a great improvement in China's material condition. We know what the potential wealth is in this direction, and one impatiently longs to bring this wealth to the surface. With coalfields, it is said, sufficient to supply the whole world for 3,000 years, China is annually importing coal to the extent of 1,400,000 tons at a cost of one million sterling. Practically, mining has not yet begun; a little scratching here and there, but except in one instance nothing is being done on a large scale. I think it is here rather than in railway extension that there are attrac-

tions for the employment of British capital, and what is of as great importance as the profitable employment of British capital is the improved condition of the people which must result from the opening of a new industry on a large scale. Left to itself, the Chinese Government is willing to leave all minerals where they are now—safe beneath the surface; but once the persistent foreigner insists on being given an opportunity of extracting them, Chinese subjects will follow in his wake, and claim their share of the newly-discovered riches. Here, as in many other instances, we shall probably fight the fight, and the Chinese will reap the fruits of victory, but it all makes for what should be our chief aim: the amelioration of the condition of the Chinese people.

In the new Commercial Treaty, which owes its existence to the Boxer outrage, China undertook within one year to conclude the revision of the existing mining regulations. She promised that

"With all expedition and earnestness she would go into the whole question, and, selecting from the rules of Great Britain, India, and other countries regulations which seem applicable to the condition of China, she would recast her present mining rules in such a way that, while promoting the interests of Chinese subjects, and not injuring in any way the sovereign rights of China, these rules should offer no impediment to the attraction of foreign capital, or place foreign capitalists at a greater disadvantage than they would be under generally-accepted foreign regulations."

This is the sort of fine-sounding obligation that the Chinese Government like to enter into, for they think that the chief value of a Treaty article is its elegant phraseology, and they have come to believe that we set as great store by the shadow as by the substance. It is now over two years since the Treaty was signed, but the new mining regulations framed in the spirit above indicated have not yet appeared. One or two sets of mining regulations, it is true, have been published, but they appear to have been framed with the object of discouraging the employment of foreign capital in the industry. They provide that in any joint-stock company the majority of shares must be Chinese owned; Chinese mine-owners may not borrow money from foreigners on the security of the mine, but only on the machinery and buildings, and this only after the permission of the official Mining Board has been obtained. The mining licences are to be for only thirty years, and may only be granted in respect of an area of ten square miles. Pit-mouth royalty on coal, antimony, iron, alum, and borax, is fixed at the rate of 5 per cent. *ad valorem*; on petroleum, copper, tin, lead, sulphur, and cinnabar, at the rate of 7 per cent.; on gold, silver, platinum, quicksilver, and spelter, at the rate of 15 per cent.; and on diamonds and precious stones at the rate of 20 per cent.

It now remains to be seen what modifications will be introduced in order to bring these rules into harmony with the spirit of the Treaty, but, meanwhile, with unknown regulations hanging over their heads, British companies or individuals are not disposed to go to the expense of making preliminary researches.

Chinese provincial authorities, for a consideration, have a way of granting exclusive mining rights to large slices of their provinces, and the concessionaires put these away in their desks until it suits them to begin operations. Thus, in the latest report of the British Commercial Attaché in China, it is stated that the provincial Government has granted exclusive mining rights in the north-east of the province of Fukien to certain Chinese and French concessionaires, and a French mining engineer of high repute has obtained a careful survey of the goldfields in that locality. These are described as very valuable, and a company is being formed to commence operations. As a precaution, it would be well to make the Chinese Government redeem their promise as regards liberal mining regulations, and meanwhile urge them to withhold all concessions until the promised regulations have been published. Otherwise we shall find all the best places have been reserved wholesale.

Internal Taxation.

If I were asked what measures would have the greatest effect on the material prosperity of China, I would say, first, the total abolition of every form of internal taxation on merchandise, and, secondly, improved means of communication. Our Treaties merely concern themselves with imports and exports, and theoretically the extent to which these may be taxed is fixed; in practice, as forty years of experience have taught us, the safeguards provided by the Treaties are effective only so long as the foreign merchant has a personal interest in the property, and keeps his eye on it. Particularly in the case of exports is the limitation fixed by treaty a delusion. Goods which may perhaps be exported eventually form part of the domestic trade of the country in the earlier stages of their existence, and during this

period they are liable to be burdened with every legal and illegal tax which ingenious and rapacious tax collectors can invent. It is only after they have been sold to a foreigner, and have been ear-marked for exportation, that the protective clauses of the Treaties come into operation. We know how the commerce between two independent countries can be injured and even killed by excessive and uncertain duties. In China it is not a question of independent countries, but of adjacent provinces, even of neighbòuring districts, one might almost say, of next-door villages. In America, I suppose a man could start with a carload of Californian canned goods, and take them through every State of the Union, and finally find a market in New York, without having been questioned or delayed, or taxed by any Government official. In China, on such a journey he would have paid out much more than the goods were worth, or he would have had to sell the best part of his cans to pay the taxes on the survivors. Under such conditions, what chance is there for any district to do itself justice by producing the very things it is most suited for, and disposing of them in the best markets? It is not only the crushing burden of taxes that the producer has to reckon with, but there are the delays, worries, and persecutions which the owner of the goods is exposed to when he ventures on a journey. In America, a man in Florida can calculate at what price and in what time he can deliver fruit in Chicago, and he makes contracts accordingly. The southern man in China can make no such calculations. His wares on arrival at destination might cost 20 per cent. more or 20 per cent less than he calculated. Production to the utmost capacity in any locality is thus much discouraged, and districts within certain limits have in a great measure to be self-supporting. The channels through which districts remote from each other can most easily exchange their products are those that exist by means of steamers plying between Treaty ports, and this relief to domestic trade is an indirect and uncalculated result of foreign Treaties with China.

It is not only the practices of the native tax officers in the interior which call for criticism and are capable of improvement. The remedy here, I fear, must wait until wiser counsels prevail at Peking, or until some events, unforeseen at present, place the foreign Powers who wish China well in a position to compel reform. The opportunity of a lifetime came in 1900 when after the Boxer affair foreign troops occupied Peking, and the terrified Government was in the mood to make adequate reparation. Here was the opportunity to render the people of China great service by exacting from them what a wise and good Government ought to give to its people voluntarily. The foreign Powers, acting in concert, need have asked for nothing which would not in the first instance have been of direct advantage to the country, and our compensation would have come later in the shape of a vastly increased trade. But unfortunately the foreign Powers interested seemed unable to act in concert, except for the rather ignoble purpose of extorting money out of the Chinese Government, which, of course, meant money extorted from the Chinese people. Everything else but indemnity seems to have been lost sight of, and day after day for some six months the representatives of foreign Powers were engaged in discussiug the ways and means of China to make up a sum of £65,000,000, and when this had been satisfactorily arranged, more discussions took place as to how the spoils should be divided. After this came the turn of the Chinese Government to apportion the debt over the various provinces, and then the innings of the tax gatherers, who proceeded to collect from the merchants and people twice as much as was required. This opportunity has gone, and if it requires the same series of atrocities to bring it back may it never return.

But there are certain obstacles in the way of trade which, as they are caused by the unreasonable application of regulations framed for other purposes, and are the direct outcome of our negotiations with China, might be removed on the representation of foreign Powers. The rules which were framed over forty years ago when the Treaty ports were few are made to do duty now when the conditions are very different. In some instances the result is absurd, but as it does not affect the resident merchant directly, the injury to trade in general is overlooked. In order to justify my criticism, I must give you one or two examples, and this necessitates a little preliminary explanation. Imports from foreign countries and exports to foreign countries pay a duty of roughly 5 per cent. This is collected by what is known as the Maritime Customs—a well-administered service organised by Sir Robert Hart. In the early days, what is known as coast trade—the French *cabotage*—really was a coast trade, that is, it meant the carriage of merchandise by foreign sea-going

vessels from one coast port to another. The duty on such merchandise is 5 per cent. at the port of shipment and 2½ per cent. at the port of discharge, 7½ per cent. in all; so here is the anomaly of the Chinese paying a higher rate of duty on what is produced in his own country than on a similar article imported from abroad. As a matter of fact, the home-made article is much more severely handicapped than this, but it would puzzle you if I attempted to explain the complicated fiscal absurdities which bring this about. You must take my word for it that it is so, and one ludicrous result is that in some cases Chinese produce is sent from one part of China to another, not by the most direct route, but in a roundabout way through a foreign country, as thereby it becomes classed as a foreign import; and such preference is there accorded to foreign imports as distinguished from native goods that it is profitable to pay two duties—one on exportation and the other on reimportation—merely for the sake of giving the article a pseudo-foreign character.

Can you conceive English-made goods from Liverpool being cleared for Antwerp and then re-imported into London, and paying duties both ways, because by so doing it escaped heavier duties? Well, this is what happens in China. The neighbouring British colony of Hong-kong, a foreign port *qua* China, seems to have been sent by providence to facilitate this operation.

This rule which requires Chinese goods from one coast port to another to pay a duty of 7½ per cent. has been extended to all places, even in the interior, which are open to foreign merchants, so we now witness the absurdity of native produce paying this duty when carried by ships between two places only a few miles apart. But still worse fiscal enormities are perpetrated in China. The disabilities under which native manufactures labour may be estimated if I give a typical case—that of matches. All the component parts, wood, chemicals, and everthing else, pay import duty at Shanghai. Then the finished article pays export duty on leaving Shanghai, and another import duty on arrival at Canton; that is, it would pay all this if it could stand it, but it has given up the attempt long ago, and now Chinese use Japanese matches. I will only cite one more instance. The north of China produces a certain kind of wild silk. There would be a sale for it in Europe if it was wound in hanks of the proper size, but this can only be done by expert hands in the Canton province. I believe one venture was attempted, but it could not be followed up because, on leaving the north the silk had to pay one duty, on arrival at Canton it had to pay another, and then a third duty when it was exported from Canton. This all comes from the bigoted idea that trade exists only to be taxed, that merchandise must pay for the privilege of moving about, and that if it cannot afford to do it it had better stay at home. This is not exactly killing the goose that lays the golden eggs, but it prevents the hatching of the egg that would produce that goose. All of which reacts very injuriously on our own trade with China.

Steam Navigation in Inland Waters.

Much was expected from the opening of inland waters to steam navigation, but again unreasonable restrictions and vexatious regulations have marred what might have been a concession of real value. Under the existing rules, one class of steamer may ply between two Treaty ports, but may not carry goods for intermediate places. Another class of steamer may carry goods to intermediate places, but may not go as far as the next Treaty ports; it must return to the port whence it started. Our English rivers are too small to enable me to give you an example, but a railway will serve the purpose. It is as if the Board of Trade were to make regulations allowing the London and South-Western Company to run goods trains from London direct to Portsmouth, but forbidding these trains to deliver goods at Guildford or Haslemere. Goods for these latter places must be sent by another train, which, having accomplished its mission, must return to London.

China is blest with a good system of waterways, and where these are available Chinese people know how to take full advantage of their opportunities, but waterways after all are but thin threads on a map, and the greater part of the country has to depend on other means of communication. Roads in China, as we understand roads, do not exist; there is a right of way and that is all. When land transport has to be resorted to, the distance which it is profitable to move goods is very limited. Cart hire comes to nearly 3d. a ton a mile; pack animals about the same; and porters' wages would work out at about 4d., but the excessive cost is not all; goods that can only be moved ten to twenty miles a day it often does not pay to move at all. Facilities for rapid and cheap transportation create a trade

where no trade existed before, as the few railways now in operation in China have amply shown; and new industries crop up as soon as means are provided for conveying the product to a market. If ever the time comes in China when her products can be moved all over the empire without let or hindrance at the rate of a penny a ton a mile, there will be no repining for the good old days. And it will be then that her commerce with other countries reaches a volume commensurate with her natural resources and the industry of her people.

It is now time that I returned to my text, and took upon myself the risky task of forecasting the future.

Future Developments.

As it has been slowly doing in the past, China's international trade, in the absence of greatly disturbing causes, will continue to grow in the future. Even without any systematic effort on either side, continuous intercourse between buyers and sellers must occasionally suggest some fresh opportunity of doing business; such an industrious people as the Chinese if left undisturbed, does not consume its capital, but continues to accumulate it; and even under the existing *régime* a gradual improvement is discernible. At the present time, we English are satisfied that we have a fair share of the China business; by-and-bye when this business has increased considerably, and our own share has also grown, we shall yet be disappointed if we find that in comparison with other nations we have not been progressing in the same proportion; but it will require more energy than we are now displaying, and also a change of tactics if we are to improve, I do not say only to the same extent, but in the same ratio as others.

If the British manufacturer is desirous of seeing a greater demand for his goods, I do not think he must look for assistance from the British merchant in China. The resident merchant in China can be trusted to look after his own interests; but he does not consider it his business to develop the commerce between East and West except when he sees a personal gain in doing so. The larger firms who have capital have tried various methods and have settled down to a beaten track which answers their purpose. They will be pleased to do a larger business with any one who comes to them; but they do not attempt to find new markets for their goods or other people's, nor to discover any new products suitable for shipment to Europe. They are satisfied that all that their own efforts can accomplish with profit has been done, and they are content to wait until more business comes their way. Indeed I imagine that some of the prosperous firms would ask "Why don't you leave well alone?" for I can easily conceive how, under changed conditions, our trade with China might largely increase without proving profitable to those already in the field. Changed conditions might bring competitors who under present conditions would have no chance.

Under the present order of things manufacturers at home can scarcely regard the merchant in China as adequately representing their interests; and although they can only act effectively in China through Englishmen resident there it would seem that they should themselves watch the course of events in that country very carefully for themselves.

British trade in China, that is to say trade conducted not only in British goods but by British hands, has undergone a transformation. The change has been gradual and has extended over many years, and those engaged in it have found it difficult to adapt themselves to the new methods. The metamorphosis is not so much in the British trader himself as in those with whom the trade is conducted, viz., the Chinese. British trade still flourishes, but its profits are no longer distributed in the same direction, nor do they benefit the same persons. The Chinese purchaser has been learning how to dispense with the British intermediary, and the smaller British merchant of the old school finds his old occupation gone. There was a time when the British merchant had few rivals in the field. Now he has many, and his European competitors are yearly becoming more numerous and formidable. They come unhampered with old associations and prepared to adapt themselves to the new conditions. Hankow is a notable example of this. For them the dwindling tea trade is a matter of no concern; they never depended on it, and they have been content to look out for something new. The silk trade also is not such a British preserve as it once was; it gives a living to merchants of other nationalities. Thus British firms grow less in number, and our European rivals fill the gap. When a new opening presents itself the aforesaid rival is quicker to seize the opportunity. Hankow is losing its tea trade with Europe, but new exports have been found to take its place. The new trade, however, is chiefly in the hands of French and German firms. Again, the Germans and the

Belgians have secured for themselves all the Chinese contracts for machinery of every description, the local arsenal, ironworks, and mint being fitted with their manufactures. The blame here, as in other branches of trade, would seem to lie with the firms in England who make no serious effort to push their goods in opposition to those of other countries. To send illustrated catalogues and price lists to local firms is not enough. The only effectual method is to send accredited agents with full particulars to the official in charge of factories in order to expound the advantages of British-made machinery, or to native merchants in order to point out the superiority of the article which they are trying to sell, and to secure orders therefor. It is the manufacturer who must go to the trouble and expense of pushing his goods and creating a demand for them. When that stage has been reached he can safely leave the rest to the resident merchant. It may be too much to ask any one manufacturer to go to the expense single-handed, but it would seem possible for a number of firms who do not compete to combine in investigating the possibilities of the China market, and share the expense of introducing their goods. For, example, the demand for mechanical appliances will grow, but it will grow more quickly if the Chinaman is not left to discover the advantage of them unaided. You must have an expert who can demonstrate that an article is needed, and then proceed to inform his customers how it can be procured.

Similar enterprise as regards their own products is not, I fear, to be looked for on the part of the Chinese people. They will neither seek new markets for their goods nor try to discover new articles suitable for export. On that side of the account, therefore, expansion will be slow, the more so that one cannot look for much assistance in this direction from the local foreign merchants. For, as in the case of imports, so also in the matter of exports have the conditions of trade changed. Where, some years ago, a few large English firms with ample capital bought China's products and sent them to Europe on their own account, there are now many small firms who receive orders from Europe or America by telegraph, and who fulfil these for a small commission at no risk to themselves. The telegraph and banking facilities have made it unnecessary to possess capital, and the business of the export merchant in China has in a great measure changed into that of commission agent. One of the consequences of this is that the commission agent who is buying on a limit, and who receives his commission on the amount of the invoice, buys on the best terms he can at the Treaty port, but feels no inducement to spend his time or his money in trying to discover new articles suitable for export. This class of men, if they had inducements to go up country in the course of their own special business, could also have served the interests of the English manufacturer, but, as things are now, they can be of little assistance.

Province of Ssuchuan.

I have already spoken of the need of better means of communication. Nowhere would this bring about a greater change than in the province of Ssuchuan. The man who likes to give free play to his imagination may see a promised land in that far western province. Here is the richest portion of China, with a large population, practically living in a state of isolation. The Red Basin, which embraces about two-thirds in extent and nine-tenths in population and wealth of the province, may be taken to have an area of about 100,000 square miles and a population of 45 millions. This basin is shut in on all sides by high mountains; clouds cover it through the entire winter, keeping in heat like a glass roof, so that the climate is remarkably mild. The result is that two and sometimes three crops are obtained in the year. Gold, copper, lead, iron, coal and many other minerals are all found in the province, and sanguine people say that it will some day supply the whole of China with petroleum. This great Ssuchuan basin has excellent water communication throughout its extent, but there is only one navigable outlet, the river Yangtze. Its trade with the districts on the north, west, and south, follows mountain roads that climb the sides of the basin. These roads are difficult and dangerous, only to be passed by caravans of pack animals, and by porters. No wheeled vehicle can reach Ssuchuan from the east, and no boat either except by the Yangtze. Steamers can safely navigate the mighty Yangtze from the sea to the town of Ichang, a distance of 1,000 miles. At Ichang, goods are transhipped into native boats which fight their way for 400 miles against the current, and through the rapids and cataracts, all the way to Chungking, the commercial metropolis of Ssuchuan. This means a journey of from 30 to 45 days, and the cost of transport comes to £4 or £5 a ton.

These boats on the upward journey are hauled up by main force of trackers, as many as 300 to one junk in the difficult places. Accidents are frequent, but thanks to the way in which these boats are built in watertight compartments, the accident seldom results in total loss. Sooner or later most of the cargo arrives at its destination in some sort of condition. In the face of such difficulties this most populous and rich province is not able to exchange commodities to any extent with the outer world. But it is not only the difficulties of transportation that restrict the movement of merchandise in and out of Ssuchuan. The Chungking merchant who wishes to visit Shanghai on business must count on being absent some three months; and the inaccessibility of the province causes banking arrangements to be very defective. Two of the most serious drawbacks to merchants in Ssuchuan are want of sufficient capital, and consequent inability to make the most of their opportunities, and the length of time elapsing between the payment of goods in Shanghai and their arrival in Chungking.

I think it has now been demonstrated that steam navigation above Ichang is so uncertain and risky, that commercially it cannot pay. Given plenty of horse-power and time for effecting repairs, a steamer may as a feat be got through; but as a business venture the idea has been given up. It is railways that are wanted to put Ssuchuan in touch with the lower provinces and the outer world, and when they have been constructed, then will the visions of my imaginative friend be realised.

The War and After.

The present war cannot but have very important consequences for the commercial situation in China. It is unquestionable that for us the best thing is a strong and independent China, so we may well be pleased at the success of Japan if it puts a stop to the insidious designs of certain Powers on the independence of that country. England is very unwilling to contemplate such a thing as partition; a broken up China would be extremely injurious to our trade, and as a last resource in self-defence we would have to join in the scramble; so we earnestly try to believe that the catastrophe is not coming, and when any ominous signs appear we look the other way. What has of recent years been going on in Manchuria, in Shantung, and in Kwangsi and Yunnan might, when the occasion suited, well lead to partition. But it is to our interest that China should not only be left intact, but that she should be able to take care of herself, for when it comes to hectoring and intimidation we are not willing to go the length of others, and our friends get the advantage of us.

There is now some prospect that Manchuria will again become a field for the enterprise of all comers; only a year ago it bid fair to become a Russian preserve. The resources of Manchuria are capable of enormous development. It has at present a sparse population, and it has been estimated that not more than one-fifth of the whole arable land is at present under cultivation. Both in agricultural products, as well as in animal and mineral products, a very large trade is possible as soon as good means of communication exist. A recent traveller makes the following observation:—

"I have travelled in different parts of China, but I never saw a sight which, from its magnitude, impressed me so much with the vast trade of China as the carrying trade from north to south in Manchuria. In one day we met at least one thousand carts, each drawn by five animals, heavily laden with the produce of the interior, beans, hemp, millet, skins, &c. In one place, where a difficult gulley had to be crossed, there was at least one mile of carts, three deep, waiting their turn to pass."

I quote this passage because it will give you some idea of what Manchuria may become when goods can be conveyed cheaply and expeditiously, instead of by slow moving carts at the rate of twenty miles a day, and a cost of five shillings a ton per day.

Taking a hopeful view of the result of the war I think we shall see Japan wielding great influence at Peking. Her prestige will be enormously enhanced, and China who all along turns a deaf ear to the advice of the Western Powers, whose motives she distrusts, will lend a ready ear to the counsels of Japan. She will be willing to accept a lesson from a nation who by its own efforts in the course of one generation has risen from what in China's eyes was an unimportant State to what in China's estimation is now the dominant power in the Far East. "What Japan has done we may yet do" will be the thought passing through the Chinese mind, and the conviction will gain force that the surest way to achieve a like success is to accept her as a guide. Whether Japan's teaching will make to our advantage will depend on the purpose which animates her in exercising her new influence. When the war is over, Japan's chief object will be to repair the waste and to set about improving her financial position.

This she can best do by building up a strong commercial connection with her neighbour, and finding in China opportunities for commercial and industrial development such as she has carried out with marked success at home. Natural advantages of position, and social affinity will give Japan much assistance, and make her a formidable rival, but the new fields to be opened will be accessible to all. If our trade with Japan has kept on growing concurrently with the great industrial development of that country, we may confidently look forward to also seeing it increase in China if Japan fortunately succeeds in making that nation follow in her footsteps.

DISCUSSION.

The CHAIRMAN said the audience had had the advantage of listening to a paper which from beginning to end had been replete with interest, and he felt sure they had reached the conclusion that alike as to ideas and suggestions it was worthy of the all-important subject with which it dealt. He also thought the illustrations shown on the screen had been admirable. The author had omitted very few facts and considerations necessary for the formation of correct impressions with regard to the present condition of British trade with China and its prospects, and in the points that he had touched upon lightly, doubtless for diplomatic reasons only, he had made many useful suggestions. Any complete unravelling of the tendency of things in China was, it seemed, practically impossible, owing to the complexity of the factors arising out of the development of the policies of foreign powers. But the author had said enough to show that they need not despair of the future of British trade and commerce in China, and he had also hinted that they were by no means confronted by any impossible problems or intangible solutions. At the same time he thought it was necessary to remember—and Mr. Brenan emphasised the point very aptly—that the British supremacy of former years no longer existed unchallenged, because foreign nations, in pursuit of their world politics as they understood them, were beginning to stand up to England and to dispute every inch of ground in which she used to be easily first. It struck him, with regard to the railway schemes, that there were two which had the greatest possible interest for those who were concerned in Chinese trade, *i.e.*, the line from Canton to Hongkong, which traversed a vast, populous, and fertile country, and that from Shanghai to Nanning, which also tapped some of the richest parts of China. With respect to shipping, large as was the English proportion to that of the rest of the whole world, yet they would more and more begin to feel that if England was to hold her own in that domain of enterprise she would have to wake up to the necessities of the situation. His own opinion was that their most formidable competitors in the near future would be their friends the Americans. He thought that if England was to have competitors in China it was fortunate that they were the Americans, because he made bold to say that in the orientation of the foreign policies of these two kindred nations, whether in the commercial, the fiscal, the diplomatic or missionary line, they saw eye to eye, and were in complete accord and agreement. He was rather glad to hear the cheer with which that remark was greeted, because he thought some present must be tempted to wish that in the matter of their home policy the Americans could equally see eye to eye with England, because who could fathom the vast potentialities or accurately gauge the possibilities of a world-girdling union of that description? It would be a great satisfaction to us to know that in the elaboration of American imperial aims, English methods of expansion would be followed, thereby strengthening the policy which made for Anglo-Saxon dominion in the Far East. He agreed with Mr. Brenan that in the interests of those who had no desire to grab territory in China it would be better if there were no partition of spheres of interest; but England, he feared, was no longer mistress of the situation. The partition of China took place three years ago. He hoped they had not let slip the golden opportunity that was presented to them when, in the course of that partition, the Yangtze Valley was given to England as her sphere of influence. Every important nation acquiesced in that decision, with the exception of Germany, who made what he considered a not unjustified reservation. She said, "We will agree to acknowledge the Yangtze Valley as your sphere of influence if you make it an effective occupation." He could not see that any special peril or risk was attached to the enterprise of making it effective, but some sort of diplomatic palsy seemed to have taken possession of English statesmen's minds. That rich and fertile valley, populated by the most peaceably disposed population in the world, appeared to have been made to pass under England's sphere of influence; the *Pax Britannica* there would have proved an untold blessing to the Chinese, and would have brought extraordinary advantages to English commerce and industry. All that was required was that several good gunboats should patrol up and down the Yangtze. He did not know whether English influence had lapsed there or become vitiated by our not having made the occupation effective, but it looked so from the free and easy manner in which Germany was acquiring railway, engineering, and coalfield rights, without the slightest reference to English views or interests. He thought Germany must have been surprised at England quietly allowing her to take all those concessions. If we had attempted similar liberties in Shantung we should very soon have found out that there were other masters besides the Chinese in that province. English policy in the Far East showed a certain amount of self-effacement, a waiting

upon events as they might shape themselves in accordance with the caprice and the pleasure of other powers. He could not imagine why it should be so. Surely it could not be because England was afraid of disturbing the European concert. He believed that concert to be an absolute sham, a snare and a delusion, because every power with the exception of America was going its own way, and was trying to work out its own salvation, irrespective of the views of the susceptibilities of England. As one interested in trade, commerce, and banking in China, he recognised Lord Lansdowne's eagerness to protect British interests, but could not help feeling that some sort of Palmerstonian mailed-fist was necessary at the present moment to assure our countrymen that, if they obtained any concession from the Chinese Government, that concession would be absolutely respected. The public were sometimes puzzled to understand the motives of our policy in the Far East. Could anyone explain why Lord Salisbury scuttled out of Port Arthur incontinently, an action which ended by despoiling Japan of the legitimate fruits of her victories, with the result that the present disastrous war was taking place in Manchuria? He did not know whether England received any compensation for that complacency towards Russia; he should think not, judging from Muscovite aggression on the borders of Afghanistan. But he only mentioned this matter to show how strange to the uninitiated like themselves must seem those occult manifestations of high State policy. The conclusion to which he had come after listening to the author's most able paper was that England had everything to expect from Japanese progress in the Far East; that Japan was very likely to join China in opening up her country and granting more facilities to the Chinese; and that if China could only be got to see that the benefit of her own people would be the benefit of her own Government, then he thought a very large stride would have been made towards the regeneration of that country.

Colonel MANIFOLD said he had been very much interested in the paper, particularly with that part which dealt with Ssuchuan, a province in which he had travelled a good deal during the past five years. It was probably one of the richest provinces in China, while its population was extraordinary. The author had referred to the prospects of railway communication in that province, and the fact that Mr. Brenan deemed it possible meant a good deal, because he had travelled extensively in that region, and had seen most of the difficulties of the country. There was no doubt that even if an easier route was not discovered than that by which Mr. Brenan had travelled into Ssuchuan, a railway line over any route not absolutely unpracticable would be a most profitable enterprise and also a most profitable undertaking for British trade. He believed the population of Ssuchuan was estimated by the Chinese at 75,000,000: the author said at a moderate estimate it would be 45,000,000. Captain Hunter and himself travelled through Ssuchuan in 1901-2; shortly afterwards they were at the Delhi Durbar, being on the staff connected with the manœuvres, and were thus enabled to see a good deal of the Delhi plain. Each of them had obtained statistics of the population of the Delhi plain, and found that the population was about 800 to the square mile. Comparing the Delhi plain in their minds' eye with what they saw of Ssuchuan, they came to the conclusion that the population in that province of China was considerably greater, and that Ssu-chuan, in many districts, must probably have a population of 1,200 to 1,500 to the square mile, which was far larger than on any agricultural area in Europe. He thought probably the author must also have noted the enormous extent to which India was interested in Ssuchuan. The trade which passed through the Customs Office, of which an accurate note was taken, amounted to about £2,300,000 per annum, which represented about one-fifth of the total trade of the Province of Ssu-chuan. Of that £2,300,000, £1,800,000 was in Indian cotton yarns, which came round to Shanghai from Calcutta and Bombay, and thence went up the Yangtse. A railway which would avoid the dangerous journey through the rapid the author had described would be of the greatest importance to India, and would probably lead, by means of extensions, to a linking up with Burma. Even in the present state of communication through the difficult channels, rapids and gorges, the Indian trade might be enormously extended. He thought everyone must agree with the author's remarks on the subject of railways in general, but unless England adopted a forward policy commercially the business would very likely pass into other hands; a sphere of influence would be set up, prohibitive tariffs and other side issues would be adopted, and, as a result, English trade would very seriously suffer.

Sir J. GEORGE SCOTT, K.C.I.E., said that in the previous September he passed up the Yangtze Valley and went over the Hankow and Peking (or Pe-han) Railway. From what he saw during that journey he could confirm the author's statement that English influence in the Yangtze Valley was declining, there being almost as many German steamers running from Shanghai to Hankow as British, and the number of Japanese steamers was quite as large. Under those circumtances he was afraid that English influence would not remain effective very long in the Yangtze Valley. The railway he had mentioned ran through the centre of the great plain of China, which was the most cultivated and populous part of the whole empire. Three hundred and eighty kilometres of the railway north from Hankow were open as far as Yen Cheng, and it was possible to get to the Yellow River in ballast trucks and waggons. When he passed through in September about 100 kilometres of the extension from

Peking south remained to be finished, but one could take tickets from Peking to Shun Tê, a distance of about 390 kilometres, and from there go in ballast trucks a further 150 kilometres. It had been announced within the last fortnight that the railway was finished, which he presumed meant that through carriages ran from Peking down to the Yellow River. The statement made by the Chairman that nothing had been done with reference to the bridge across the Yellow River was not correct. The proposed bridge was to be about two miles long, and the approaches on either side to the extent of probably half of the distance had been completed; but the most serious part of the work yet remained to be done. The engineers of the work, who were principally French, were not at all confident that the bridge could be built, owing to the enormous depth of shifting soil in the river bed. Forty feet screw piles were being driven into the river bed, and abutments, composed of enormous piles of rock and concrete, were being built; but from the experience gained on a number of rivers of a similar character in the country the engineers were not at all sanguine of the result, because after the heavy rains of the previous year a great many of the smaller bridges which were built on the system proposed to be adopted on the Yellow River had been very seriously damaged. When the railway was finished enormous quantities of goods would be landed at Hankow, but he did not think those goods would be carried in British ships. Ten years ago, when Mr. Brenan was last in Hankow, probably no French was spoken, but it was now the ruling language on the railway line. The engine drivers, the men in charge of the coolies, and the railway policemen all talked French, and while the railway was called a Belgian railway, nearly all the capital had gone into French hands. The French, Germans, and Japanese were very greatly undermining English influence on the Yangtze, and unless England built a railway from Burma and Shanghai, in answer to the trans-Siberian Railway and the French railway from Tonking, he did not think she would maintain her influence in the Yangtze Valley.

Mr. R. S. Gundry, C.B., thought everyone present would agree with the remarks the Chairman had made in regard to the political situation, and the regret he expressed that England stood aside, while France, Germany, and Russia were allowed to despoil Japan of the fruits of her victory in 1895. A precautionary clause guaranteeing the integrity of Korea and stipulating that, if Port Arthur were retroceded to China, she should never alienate it to another Power, might have gone far to prevent subsequent trouble. The self-abnegation (should he call it?) displayed in that case was followed by the still more remarkable withdrawal of British ships from Port Arthur at a moment when the Russian ships were under orders from St. Petersburg to leave, and if the British ships had stayed there another twenty-four hours, they would have found themselves alone. The present war between Japan and Russia seemed to flow directly from those permissions, just as all that Russia had done in Manchuria flowed from the Cassini Convention. A policy of spheres of interest or influence held the field for a period after the withdrawal from Port Arthur; and the impression was certainly conveyed to the people of this country that the Yangtze Valley had been secured as the English sphere. The first nail that was driven into that proposition was the giving of the concession for the Peking-Hankow railway to a Franco-Belgian company. The China Association, with which he had then the honour to be connected, addressed a letter to the Government when the question was at its height, suggesting that the concession ought to be secured at all costs for England if British interests were to be preserved in the Yangtze region, as it was altogether inconsistent with those interests that a great railway, built by Franco-Russian capital and supported by Franco-Russian diplomacy, should be driven down into the heart of the Yangtze, and that, inasmuch as private enterprise could not fight State-aided enterprise, the Government should guarantee $2\frac{1}{2}$ per cent. on the £5,000,000 required to construct the railway. The project did not find favour, and some of the consequences had been made apparent by the last speaker. The rival policies of "spheres of influence" and of "integrity and the open door" would be revived, probably, in the negotiations which would attend the termination of the present war. He imagined there would be a marked division of the Powers when that question arose, for certain of them which were interested in extending and strengthening their influence in China would be interested in letting Russia down as quietly as possible in Manchuria. In the other camp would be found England, America, and Japan, who had declared in favour of maintaining the integrity of China, and they should be strong enough, if they stuck to their determination, to carry it through. It was not a policy, however, which could be achieved by pious aspiration alone; a very decided opinion would have to be expressed if it was to be carried through.

Mr. J. D. Rees, C.I.E., remarked that the author of the paper had spoken of China after the present war accepting the guidance of the Japanese. That was really a very innocent statement; but he thought it was worth while getting from a speaker who enjoyed a reputation such as Mr. Brenan had, exactly what he meant by that statement. At the present moment, when Russia, crushed in the field and troubled with internal revolution, was at her wit's end to justify her conduct in any direction, a great deal was heard, even from those who should know better, about the Yellow bogie; and he should be glad to hear from the author that when he referred to China taking the advice of Japan, he did not contemplate any alliance between those nations for the purpose of making any hostile attack upon the West. Mr. Brenan well knew that

the Chinese and Japanese were no more likely to combine together to attack the West, than France and England were likely to combine to go on a filibustering expedition, to attack the East; in fact, the one was just as likely as the other. But, in spite of that, responsible organs, occupying a position in foreign countries similar to the position held by *The Times* in England, were constantly putting forward that statement as a possible fact, with the object of looking to the end when the powers would come in again to divide the spoils which they hoped to get at the conclusion of the present war. He himself had been called a "foreign devil" from Canton to the country beyond the Great Wall, but he had accepted the epithet as descriptive and not abusive. He was treated there with some kindness and consideration, and he was, therefore, glad to hear a paper in which China was not visited with unmeasured abuse and condemnation. He was roughly handled the other day in Scotland for describing Japan as a comparatively free trade country. It was a comparatively free trade country compared with its neighbours, China and Russia. The influence of Japan upon China would all be in the direction of free trade; it was not likely to have any other effect. He hoped the author would be able to state that that was the only respect in which he meant that China was likely to follow the lead of Japan after the war was over. He hoped every occasion would be seized for dispelling the foolish Yellow terror, which was being put forward simply in view of some unjustifiable arrangement for robbing Japan of her victory, as took place on a former occasion, when she was despoiled of Port Arthur.

Mr. BRENAN, replying to Mr. Rees, said that if his forecast turned out to be correct, and if China, accepting the teaching of Japan, embarked on a course of reform, and became, as well she might, even more powerful than her teacher, still in his opinion this need not cause any alarm to Western nations. Neither China nor Japan were ambitious in the sense of being aggressive. They needed to be strong for the purpose of defence; but neither Power, however strong it might become, would be likely to use its strength on our side of the world; it would be used for protecting the Far East from the encroachments of Western nations. Japan has been showing us how she can use her strength in this respect. It would not be surprising if Japan's success suggested to her the advisability of further increasing the powers of resistance by calling into life the latest forces of China, and effecting an alliance for mutual protection; and in the accomplishment of this design both countries had the speaker's good wishes. For China to become strong she must go to the expense of organising and maintaining efficient and adequate forces. The want of money for these purposes might stimulate her to adopt wise measures for the development of national wealth and prosperity; and a strong, wealthy, prosperous China had been the keynote of the speakers' remarks this afternoon. The Yellow peril need cause alarm to no one who had honest intentions towards China. The nations who had visions of a Yellow peril were those who liked to fish in troubled waters, and who looked on the Far East as a happy hunting ground. For these a Yellow peril would undoubtedly exist in an alliance between China and Japan, and in the interest of law-abiding nations it was desirable that the peril should exist.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Brenan for his most interesting paper, said the author had elucidated one particular point on which they all wanted some sort of assurance, *i.e.*, that the advance of Japan and her progress in the commercial and military world betokened no kind of danger to any nation on the face of the earth. In replying to Mr. Rees's question, Mr. Brenan had assured them that, at all events in his view, there was no such danger looming before any nation.

The resolution was carried unanimously.

NINTH ORDINARY MEETING.

Wednesday, February 8, 1905; GEORGE DAVISON in the chair.

The following candidates were proposed for election as members of the Society:—

Allen, Caleb J., Hillside-house, Lancaster.
Allis, Edward Phelps, jun., Palais Carnoles, Mentone, France.
Bingham, Charles Henry, 13, Great Brunswick-street, Dublin.
Cloud, John W., 82, York-road, King's cross, N.
Colabawalla, Dinshaw D., care of Dr. Framroze C. Thanawalla, Aga-buildings, Bhendy Bazar, Bombay, India.
Johnson, Edward, 605, Salisbury-house, E.C.
Kelly, Alexander, 100, Hyde-park-street, Glasgow.
Llanos, Eduardo, 96, Leadenhall-street, E.C.
Parish, William Francis, jun., The Vacuum Oil Company, Ltd., 4, Norfolk-street, Strand, W.C.
Polden, Francis C., A.M.I.E.E., The Rhodesia Railways, Limited, P.O. Box 420, Bulawayo, Rhodesia, South Africa.
Schumacher, Harry A. P., 333, Calle Echaurren, Santiago, Chile, South America.
Sprague, Thomas Bond, LL.D., 29, Buckingham-terrace, Edinburgh.
Stuart-Fox, Julius J. S., The Western Telegraph Company, Ltd., Rio de Janeiro, South America.
Welbury, William, Middleton-crescent, Leeds.
Whittome, Philip Alfred, 23, The Chase, Clapham-common, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, David, Ashdale, Satanita-road, Westcliff-on-Sea.
Childs, Harry, 47, London-street, Reading.
Dawbarn, Alfred H., 1, St. James's-place, S.W.
De-la-Motte, Freeman Alexander, Cadnant-park, Conway.
Gabbett, Edward, Public Works Department, Maymyo, Burma.
Hobhouse, Mrs., The Ridge, Corsham, Wilts.
Hyde, John, Lanier Heights, Washington, D.C., U.S.A.
Kodandaramiah, Khajana; Sompet, Ganjam District, Madras, India.
Macaulay, Thomas F., Rosbrien-house, Limerick, Ireland.
Mahler, Miss E., Sudworth, New Brighton, Cheshire.
Morris, Steven William Savin, P.O. Box 691, Cape Town, South Africa.
Munro, Laurence, Kronsbein-building, 10, Main-street East, Hamilton, Ontario, Canada.
Pottie, George, 42, Mansfield-road, Ilford, Essex.
Powell, A. H., Neston, King's-avenue, Ealing, W.
Rees, John David, C.I.E., 17, Pall-mall, S.W.
Sadler, Henry Knight, 5, St. Andrew's-place, Regent's-park, N.W.
Slessor, Major Herbert, R.M.A., Eastney Barracks, Portsmouth.
Smith, Harold Bayldon, A.R.I.B.A., 11, Constitution-hill, Port Elizabeth, Cape Colony, South Africa.
Straker, Donald, Haslemere, Surrey.
Waugh, Percival Bentley, Whitehall Club, Parliament-street, S.W.
Whitehead, Sydney, 24, Queen's-road, Wimbledon, S.W.

The paper read was—

TIME DEVELOPMENT IN PHOTOGRAPHY AND MECHANICAL METHODS OF CARRYING IT OUT.

By R. Child Bayley.

Time development may be defined as the development of the latent image in a photographic film regulated by the time during which a standard developer has been allowed to act, in distinction from development controlled by ocular examination of the result. I hope to show how it originated, to consider the objections to it and their cause, to discuss how far it is practicable, and to describe the mechanical devices at the disposal of the photographer who chooses to adopt it.

When this Society gave me the opportunity of bringing this subject before it, it was seized with no small degree of pleasure, because while much has been written and said concerning the controversial matters which underlie the subject, the practical outcome, so far as I am aware, the art—using the term as it should be understood in this room—has been to a great extent ignored.

Modern, even as photography goes, where the practices of ten years ago are old fashioned, we must still go back quite to the early days of the gelatine dry plate if we are to trace the growth of the principle which concerns us to-night, and especially if we are to understand the opposition with which so revolutionary a doctrine has been met, since that opposition is undoubtedly to be traced to the wet collodion process and its manipulations.

Photography with gelatino-bromide emulsions rapidly supplanted wet collodion in the early eighties. So quickly did the change take place, that we did not see the change of *personnel* that other sweeping alterations have brought about. The railway engine-driver was a totally different individual from his stage-coach predecessor; the linotype operator, as I can testify, is by no means of the same type as the compositor; the chauffeur is most certainly not a modified groom; but the dry-plate worker of those days was the wet-plate worker who had taken up a new process. He was the same man, working in the same place, with many of the same tools, although with a totally different process, and he came to the gelatino-bromide plate with a mind as indelibly marked with collodion ideas and methods as his fingers were with the silver bath. The consequences of his prepossessions are hardly yet shaken off, and it is to those preconceived ideas that we owe the fact that the principle of time development has taken more than ten years to influence to any marked extent the general practice of photographers.

Let us see for a moment what those prepossessions were.

The development of a wet plate was essentially a process of silver intensification. The exposed silver iodide and bromide were treated with a solution in which was silver nitrate on the verge of reduction, and it was by the deposition of metallic silver originally dissolved in the developer that the image of the negative was built up. There is no evidence to show that the silver in the silver haloid originally exposed formed part of the final image at all. It probably did, but it played a very small part therein, and the actual density was due to the silver applied after exposure in the

developer, or present during exposure in the solution the plate picked up while it was in the nitrate bath. Had the development of a dry plate been a physical intensification process of this kind, I should certainly not be addressing you to-night on this subject.

It is true we hear very little in the wet-plate days of the possibilities of correcting under or over-exposure by development (under-exposure has never been regarded as curable, by the way). This was due to a large exent to the fact that in the great majority of cases the work of development was performed immediately after exposure, and the simplest way of remedying any defect of that nature was to take a clean piece of glass and make another exposure. But the character of the negative could be very greatly modified by variations in its development, and the wet-plate worker came to the gelatine process expecting to find that he had as much control with it as before; and he was not apparently disappointed.

He was taught that if he had over-exposed, by the addition of a plentiful supply of an alkaline bromide to the developer he could so modify the results that it would be difficult, if not impossible, to tell an over-exposed from a correctly-exposed plate.

And this, no doubt, is perfectly correct. To the average photographer, a plate which has received four, or even eight times the exposure which it ought to have received, if developed upon the old-fashioned lines, gives a negative which by itself and without a correctly exposed negative with which to compare it, seems very much what it should be. But it is not by any means the same thing, as we shall see.

The reason for this belief is easily found. The most prominent characteristics of an over-exposed plate, developed as if it were correctly exposed, are a great density and fogginess over the whole surface. Instead of the image making its appearance gradually, the highest lights first appearing and getting denser and denser, until when development is complete they are very much more opaque than the shadows, we know we have a plate on which the image flashes up and the shadows begin to darken before the high lights have had much time to acquire density. By the use of a developer containing a considerable proportion of an alkaline bromide, this is to a great extent prevented. The developing process takes much longer, but in the end we get a negative in which the highest lights have as much density as we require; but thanks to the bromide, the deepest shadows, instead of being almost as dense, are nearly if not quite as transparent as if the negative had been correctly exposed. Such a negative gives a print in about the same time as if it had been correctly exposed; in such a print the high lights are as bright and the shadows as deep as we want them, and, superficially, the remedy for the over-exposure has done its work.

In the early days of the gelatine process, to put the matter in another way, the extreme ends of the scale of light intensities or densities were alone considered.

This can be seen in the Warnerke sensitometer, by which or by kindred appliances it was customary in those days to test plate speeds. A plate was exposed in such an apparatus in a series of steps, and the least light action perceptible was taken as a measure of the rapidity of the emulsion. Those who used the Warnerke sensitometer to any great extent and critically, soon found that, apparently, its readings were not always borne out in practice. Even to the eye, it was seen that of two plates used in the camera, one might do with less exposure than the other, although both gave the same reading in the sensitometer. It was therefore proposed, I believe by Mr. W. E. Debenham, that instead of taking the faintest perceptible image on the plate exposed in the sensitometer as the indication of its speed, we should take into consideration only those parts in which it might be said we had a printable image. In fact, as we should express it now, that we should deduce the speed of a plate from observation of the period of correct exposure. The advice was excellent, but it made the Warnerke sensitometer cease to be an instrument of precision. The last number visible, was a matter about which there could be little doubt; but the extent of the printable image was an ideal subject for unlimited debate; and the sensitometer used in that way, if it gave results more harmonious with actual practice, gave them only as the roughest approximations.

Such was the general attitude of photographers towards the subject of gradation during the eighties. Search as we may throughout the very copious literature of photography in those days, we find very little importance attached to truth of tone, very much to adequate contrast for printing. The trouble always seemed to be to get strong negatives, and the ideal put before the worker of those days was described in phrases reminiscent of the advertisements of a wine

merchant, such as a rich, a plucky, and even a "juicy" image. Captain Abney, it is true, had devoted some attention to the subject, as can be seen on reference to the 39th chapter of his "Treatise on Photography" (6th ed. 1890, Longmans), but little attention seems to have been given to his work. He noticed at any rate that "the tendency in all negatives is to cause a loss of gradation in the deep shadows as well as in the lights," a fact which will concern us very much later on.

In May, 1890, a paper entitled, "Photo-chemical investigations and a new method of determination of the sensitiveness of photographic plates," was read by Dr. Ferdinand Hurter and Mr. Vero C. Driffield, before the Liverpool Section of the Society of Chemical Industry. That paper, which it is hardly an exaggeration to describe as the very foundation-stone of the vast and still growing edifice of modern photography, laid it down as an axiom that:—"A negative is theoretically perfect when the amount of light transmitted through its gradations is in inverse ratio to that which the corresponding parts of the original subject sent out."

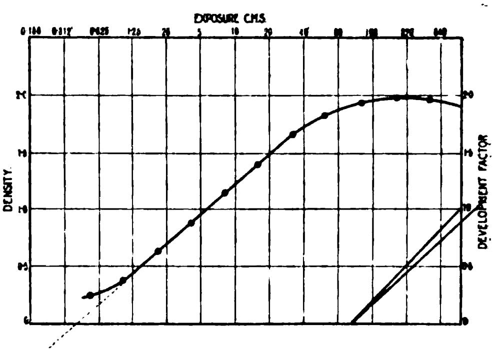
In the conflict which followed the reading of that paper I can find no trace of any opposition to the soundness of that view, and we may assume, therefore, that, as far as their definition of a perfect negative was concerned, it was accepted by photographers without demur.

The paper went on to describe a lengthy investigation made to ascertain the exact conditions under which such perfect negatives may be produced, and there also little of a contentious character was offered. It is only when we come to the subject of the development of under and over-exposed negatives that its authors raised a whirlwind of opposition and denial, but even that has now died down sufficiently for us to see how far they were accurate in their experiment, how far they were justified in their conclusions, and how far the work they then did has influenced modern photography. It is with that influence that we are now mainly concerned.

Taking then as a basis that "a negative is theoretically perfect when the amount of light transmitted through its various gradations is in inverse ratio to that which the corresponding parts of the original subject sent out," Messrs. Hurter and Driffield proceeded to show that given suitable conditions, such a negative was obtainable. Such a negative is one of which the densities are proportional to the logarithm of the exposures.

At a risk of going over ground that is familiar to you all, I will ask you for one moment to look at the diagram on the screen (Fig. 1), which represents what they termed the "characteristic curve" of a commercial plate. This curve has been obtained by giving the plate a series of exposures increasing in duration in geometrical progression, developing it for a standard time, in a standard developer, at a standard temperature, measuring the densities so obtained and plotting them in the way shown. The method of plotting is essentially a convenient device by which we can see at a glance to what extent the densities are proportional to the logarithm of the exposures, since in the case of a curve with densities as ordinates and logarithms of exposures as abscissæ, when any number of these are proportional the line joining them is straight.

FIG. 1.



These characteristic curves are now familiar to photographers, and more than one opponent of the views of the investigators who devised them have been obliged to express their results in the same way. The figure is a typical curve, which represents a well known and popular dry plate. It will be seen that the curve divides itself into four portions. First, a strongly curved part, where the exposures have been shortest, then a part which is practically a straight line, beyond that another curved part which takes us to the maximum density obtainable, and finally a descending curve, the reversal period, about which we need not trouble ourselves at present.

Messrs. Hurter and Driffield showed that so long as the entire range of exposures lies within the limits defined by the straight portion of the curve, the negative will comply, to a certain extent, with the conditions of theoretical perfection before mentioned.

They also ascertained by a series of experi-

ments, which have recently been repeated and fully confirmed by Messrs. Mees and Sheppard with a degree of refinement the original investigators can hardly have contemplated, that variation in development as practised by photographers has no effect whatever upon the density ratios of the negative. In other words, the straight part of the curve remains straight, however the developer might be modified, and the curved parts remain curved. When speaking of modification in the development, it must be understood that reference is made only to such modifications as were practised by photographers with the idea of remedying errors of exposure.

It is possible by complete alteration of the developer to modify the curve enormously, almost in fact, irrecognisably, but such methods are not of practical importance, and are rather of the nature of scientific curiosities. Given a developer which does not fog the plate, which is free from solvents of the silver salt such as ammonia, the only way in which the straight part of that curve can be modified is in the angle, which, when produced, it makes with the base line; it will always be straight, and it will cut the base line at the same point. Although, generally speaking, this remark holds good of alterations of the active developing agent, as well as of alterations in the strength and composition of a solution in which the active agent is always the same, there are certain developers, the use of which shifts the point of intersection very considerably. The result is that with these developers the plate is faster or slower than it is with others, a fact pointed out by Hurter and Driffield in their very first paper. Such alterations, however, are not used as methods of control, although, where the shortest possible exposures are demanded, photographers may use such a developer as will make their plates give a faster reading than the re-agent which they generally employ.

The variation which we do get by alterations in the composition of the developer, such as used to be recommended for the cure of incorrect exposure, can be effected by alteration in the time of development, in the temperature of the developer, and in the composition of the developer, or in two, or in all three. As it is always desirable, where control is to be exercised, that the control should be direct and simple, it follows that, since all the useful control we can effect can be got with variation in the time only, there is no need to vary the other factors, and one uniform developer, applied at a known temperature, will do all that we can require of it, provided the exposures have been correct.

Here then we have the basis of time development. The development of the plate is effected by a standard developer at a standard temperature, any control required being obtained by altering the time of development and that only.

Theoretically, we can alter the time of development in each case to obtain negatives to suit various printing processes, or to make different classes of subjects suitable to the same printing process, and to some extent this is done. Thus we hear of negatives being made "strong" because they are wanted for carbon work, or "kept thin" for enlarging. At the same time, it often happens that the result aimed at in this way is not attained, and many a photographer whose work is of a varied character, uses two or three different printing processes, so that he may be able to print a negative by the method best suited to it, whether that method was what he aimed at in development or not. The utilisation of the entire range of a printing paper is comparatively unimportant; and a negative with a development factor of 1·2, expressed in the Hurter and Driffield manner, if correctly exposed, will give a result by most printing processes (except perhaps by straightforward enlarging on bromide paper), to which the most captious would not take exception.

It is interesting to note, in this connection, that using the developing powders supplied by Kodak, Ltd., with Kodak film in the Kodak machine, to which I shall refer shortly, exactly as specified, gives us a development factor of 1·1 to 1·3.

This question of the development factor is an important one, as it is that on which there is the greatest degree of misconception. It has been urged against the proposal to develop for a fixed time, that a development factor that suits a portrait does not suit a landscape or an interior. Strictly speaking, this is perfectly true. In the same way, to get the best possible results, quantitative experiments have shown us that we require a higher development factor for negatives that are to be printed in carbon than for those that are to be printed in platinum, for platinum than for ordinary silver paper, and so on. But actually and in every day practice, the professional portrait photographer is the only worker who aims definitely at a result suitable for one particular printing process and that only. The average photographer, amateur and professional, aims rather at

an average result, he wants a negative which will suit him for any process he may fancy. Nay, more, he expects the same negative to give him a good contact print, and a good enlargement. Yet on the same printing paper, the former requires a very much higher factor than the latter, two-thirds as much again in point of fact.

To do this he must aim at an average result, and to tell the truth, a plate that has been correctly exposed and developed for such an average result, is so much better than nine-tenths of the haphazard results of incorrect exposure and "controlled" development, that those whose photography has merely for its aim excellent prints, and is not carried out with a nobler polemical purpose, are more than satisfied with it.

Such an average result it will be found is to be obtained by timing the development so that the factor is approximately 1·1, which it will be seen is not very far from the figures given by the Kodak method.

If we have a correctly exposed plate, and we develop it invariably in a standard developer at a standard temperature for a length of time to suit that particular plate, we shall find that it will give us a negative, not in every case as theoretically perfect as it could be made with more elaborate precautions, but a great deal more perfect than it could be made by any empirical procedure guided by mere ocular examination; and that not once but every time, with a minimum of trouble and a complete immunity from light fog.

So far I have been speaking only of correctly exposed plates. Let us now consider the question of incorrect exposures. The development applied to a correct exposure should be that best calculated to suit an under-exposed plate. For manifestly, if with much shorter exposure we could get the theoretically perfect negative by any modification of the developer, that would be the course to adopt in practice every time. No one wilfully throws away rapidity in an emulsion. And as a matter of fact it is so. An under-exposed plate developed by time as if it were correctly exposed, gives us the best possible result we can hope to obtain. Clear, but lacking in vigour, if the under-exposure is not too great, the plate can be intensified up till it attains sufficient contrast to print. It will never be a "perfect negative," either theoretically or practically; and I am not aware that any method of making it so has ever been devised.

The question of over-exposure is one which requires more consideration, because there are many photographers who believe that methods they employ enable them to determine during development whether a plate has been over-exposed or not, and if so, to remedy it so that in the final result the change brought about by the excessive exposure has been entirely counteracted during development, and the plate shall in no way differ from one correctly exposed and normally developed. The belief takes its origin in the old practice to which I have already referred, of judging a negative, not by the truthfulness of the whole of the gradations upon it, but by the visual appearance of its highest and lowest tones, by its clearness and contrast in short. The most obvious difference between an over-exposed and a correctly exposed plate, when both had been developed until the highest lights were equally dense, was that the former had much more deposit in the shadows, and, in consequence, much less contrast all through. A method of development which gave the plate contrast and prevented much of the blocking-up in the shadows, was supposed to cure the over-exposure.

The moment methods of measurement more accurate than ocular examination were applied to such negatives, it was seen that, so far from the over-exposure having been cured, its effects were as marked in such negatives as if they had been developed in the ordinary way. The density of the highest light and of the deepest shadow had been made to correspond perhaps with those on the plate that was correctly exposed, but the intermediate tones were as untruthfully rendered in the abnormally as in the normally developed plate. It is a curious fact that, while this method of "curing" over-exposure has satisfied that large body of photographers whose tastes are not sufficiently scientific to lead them to examine the subject for themselves, and whose artistic sense is not sufficiently keen to show them the essential falseness of the results so attained, I have known several workers, without the slightest claim to any knowledge of the principles of development, whose sense of tone value was sufficiently acute for them to detect at once that there was something wrong in these cases of fancied cure. They could not put their fingers on the cause, as we can now, but the symptoms to their trained observation were patent.

All the investigations of the last fourteen years go to show that over-exposure is not in

any sense curable by methods at present available. Prevention, says the proverb, is better than cure; and some of those who think it their duty to defend practices long since shown to be unsound, only do so by revealing their incapacity to grasp and employ preventive measures. If over-exposure cannot be remedied, the question still remains, what is the best way of dealing with it?

To answer that question, let me put another. If modification of the developer will not bring about the change we require, why should we modify it? The simplest and the most efficient plan to secure results from over-exposed negatives is to develop them for the same length of time and then either to print them as they are, which presents no difficulty with development papers, or to reduce them with such a solution as the ferricyanide and hypo reducer until they are sufficiently thin for the purpose required. But let me add once more that neither this nor any other device "cures" the over-exposure. It only makes the best of a bad job.

It will be seen, therefore, that the result of the investigations of exposure and development which so far have been carried out, points to two conclusions:—

1. The supreme importance of correct exposure.

2. The powerlessness of modification of the developer to remedy errors of exposure.

I hope that I have made clear that from these two conclusions we can draw a third, namely, that if all our negatives receive identical development, identical, that is, as regards composition of developer, temperature of developer, and time of development, provided that treatment is the best for a properly exposed plate, it is at least as good for all as any series of modifications can be.

So far, however, we have only reached the conclusion that it is as good as other methods. We will now see whether such a method brings with it any other advantages. Manifestly, if we are going to treat all our exposures alike, the need for some method by which we can watch the development of the plate vanishes. We neither have to determine from its appearance whether to modify the developer or not, nor when development is complete.

This brings two advantages in its train.

The risk of light fog, or rather the degree of light fog is reduced, because every plate developed in the dark room, as we know it, is fogged more or less, generally I am afraid, more rather than less. No light worthy of the name is "safe" for prolonged development; and although I am aware that such an objection may seem hypercritical, and my audience may know that in their own practice those of them who develop in the dark room get negatives to all intents and purposes free from fog, the enormous majority of the negatives which I see, and I see many hundreds in the course of a year, are fogged, and badly fogged, either from the dark room illumination, or from an unsuitably compounded developer, or from both.

Quite apart from the risk of fog, the determination of the point at which to take the plate out of the developer is a difficulty even with the most experienced photographer, if his only means of ascertaining it is by looking through the negative at the light. The apparent contrast obtained is not necessarily the actual contrast, since it is affected very largely indeed by the thickness of the coating of emulsion on the plate, and to a small extent by the brightness of the light by which it is examined. This latter may be made constant, but the former cannot; and although modern machine coated plates are remarkably uniform as far as any one batch is concerned, I have found considerable differences in the thickness of the coating on plates of the same brand but made presumably some days or weeks apart. When the conclusion of development is settled by the clock these sources of error disappear entirely, and hundreds or thousands of plates can be developed with a degree of uniformity which is to be attained in no other way.

It is for these reasons that a good many years ago now I became a convert to the method of working known as time development. Its advantages may be summarised thus:—

1. It gives us perfectly uniform negatives when exposure has been correct, whether we develop daily, or only have a few to deal with every now and again.

2. It brings everything out that can be got out of an under-exposed plate, and removes the temptation to over-develop in the hope that more details may be obtained.

3. It gives us as good a result as can be got with overexposed plates, and prevents any risk of insufficient development which may be caused by the difficulty of judging how far development has gone when the plate is very opaque.

4. It reduces light fog to a minimum, and in the case of roll films does away with it entirely.

5. It overcomes entirely the difficulty of determining when development is complete.

6. It can accommodate itself to the nature of the subject or to the printing process to be used, or may be settled once for all to give a good "all round" negative.

Modern Mechanical Methods of Time Development.

I now reach the second portion of my paper, which deals with appliances for time development. Before referring to them more specifically, it would be well to point out that there are two distinct systems by which time-development can be accomplished. In one, we note the time taken for a certain part of the image to make its appearance, multiply that time by a factor which depends upon the developer used and the development factor at which we aim, and take the result as giving the time of complete development. This is the Watkins system, and as it has already been brought before this Society by the gentleman best qualified to deal with it, I need not, to-night, go over the ground already covered by Mr. Watkins, but will merely refer to the *Journal of the Society of Arts* for December 5th, 1902 (vol. li., p. 42), in which his paper will be found.

Before leaving Mr. Watkins's system, I would like to make one more reference to it. It has been urged against his method of development, that it results in under-development of cases of over-exposure, and if his rules for development are rigidly carried out without exception, there is no doubt that this is the case.

It has been foreseen by him, however, for in a passage in his book which describes his method, speaking of over-exposure, he says (p. 82) "it is, perhaps, even a better plan to develop half as long again, and afterwards reduce with the ferricyanide reducer, which reduces the lower tones more than the upper." It must never be forgotten in considering the Watkins method that it is one which deals both with exposure and development; and that those who master his system and bring merely an average degree of intelligence to bear upon its application to their own practice, will not know much about over or under-exposure except what they read.

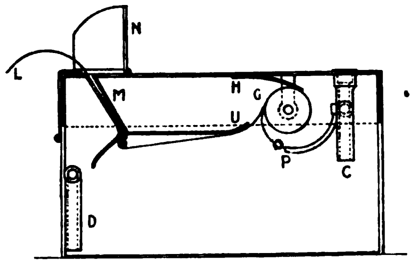
In the other system, a definite developer at definite temperature is allowed to act upon the film for a definite time, no inspection of the image being necessary, nor indeed with some forms of apparatus, possible. This is the method adopted in the "Tyma" and in the "Kodak" developing machines, examples of both of which are before you.

The "Tyma" machine, which is the invention of Mr. Max Reichert, was patented in 1901 (No. 14079), and was the first time development machine to make its appearance on the British market; having originated, so its inventor informed me, from an editorial article of my own, written and published in *Photography* in the previous year. It is a curious fact that, so far as my examination both of British and American patents has gone, the "Tyma" is the one and only mechanical apparatus for time development for which protection has been granted, if we except the various forms of automatic photographic machine in which the principle had necessarily to be employed, but in which the development was only one incident in a series of automatic operations. Even the best known, and certainly the most ingenious of machines, the "Kodak," as we shall see later, was protected, not as a machine for time development, but with the necessary window and peep-hole for examining the progress of the operations. For a good many years there have been quite a number of patents granted for enclosed dishes or stands in which development can be carried out, but they all provide for the necessity of watching development. In fact, they are simply little dark rooms, outside of which the user remains and watches through a ruby glass what goes on. Yet the patentee of the "Tyma" in his specification talks of "the well-known principle of time development." The "Tyma," however, has fallen from grace, and in the latest pattern, which is on exhibition, it will be seen that it is provided with a sliding shutter which covers a ruby window, although this cannot be of much service as the opening is along the edges of the film.

The two diagrams now on the screen (Figs. 2 and 3), are taken from Reichert's specification, and will serve to make the working clear. One or two minor alterations have been made in its general design, for manufacturing purposes, but it is still essentially what is now seen in these slides. It consists of a metal or other box, with a light-tight lid. In the box and lid are three openings, D and C, circular tubes for the passage of the solutions, and M a flat tube practically the width of the box. The way in which the film was immersed was a very ingenious one, and in my own practice—and I used the "Tyma" for some little while with perfect satisfaction—never failed. The spool of film with its black paper was placed

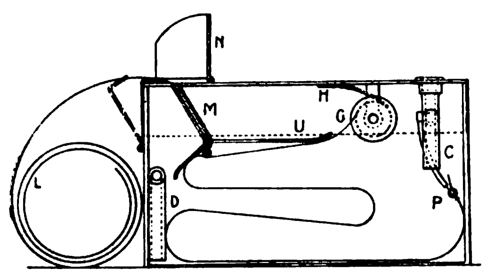
on trunnions provided for the purpose at G. The black paper was unwound a little, H being a spring to prevent the spool from unwinding too readily, and was led along under the finger or guide U and pushed up through the flat tube M until it came out of the top; N is a little flap which is raised while the black paper is first put through, and is pressed down again so as to serve as a light trap as soon as

FIG. 2.



there is enough at L to catch hold of; P is a little clip, in which the extreme end of the sensitive film is gripped. All these operations are performed in daylight and very easily, as the various parts referred to are all attached to the lid, which can be removed and turned up side down for the purpose. Then, as much water as can be poured in without causing the syphon to operate is put into the body of the apparatus, and the lid is put on. We then have the state of things shown in Fig. 1,

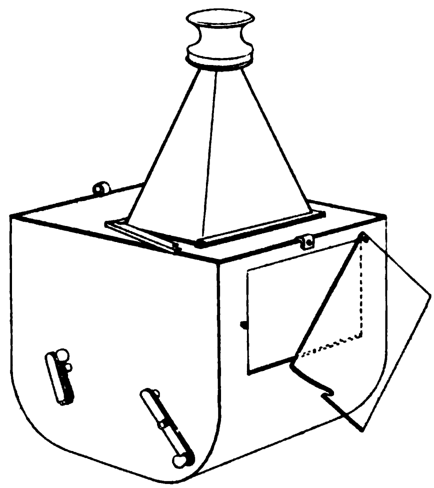
FIG. 3.



except that the flap at N is closed. On pulling the end of the black paper L the spool unwinds, the black paper comes out of the box, and the sensitive film, film side uppermost, forms a series of loops below the surface of the water. When the end of the film is reached, being attached to the black paper it enters the tube M, where by a contrivance for the purpose, the extra thickness of film and paper jams, the photographer knows that his spool is all unwound, and the film is held for the subsequent operations. These consist of syphoning out the water, pouring in a definite developer for a stated time, gently rocking the tank meanwhile, syphoning off the developer at the end of that time, and washing and fixing the film in a similar manner, when the lid can be taken off and the film removed for the final washing and drying.

The same inventor has made a machine for plates, but this need not concern us, as no mechanical methods yet devised for them enable us to do away with the dark room, or indeed present any noteworthy advantages over an ordinary dish provided with a light-tight cover, which is what I use myself for such work.

FIG. 4.

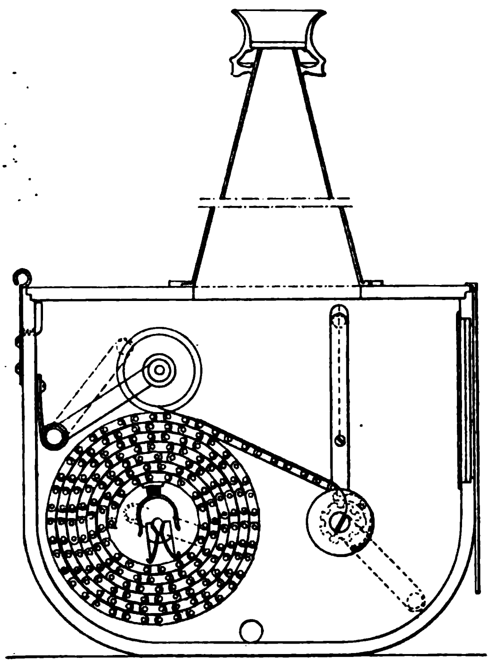


We now come to an instrument which is, I expect, well know to everyone in this room—McCurdy's patent apparatus—which has evolved into its latest form, very different from the original one, the "Kodak" developing machine.

The slide now on the screen (Fig. 4) shows the external appearance of the Kodak developing machine in the form in which it was protected by McCurdy (Patent No. 21243, 1899). You will observe that while it is a very different affair from the machine as it now comes on the market, there is more than a suggestion of it, both in general shape, in the two spindles with external handles, and in the chain which subsequently developed into the well known celluloid apron. The internal structure is shown in the next slide. (Fig. 5.) The stages in its development which intervened between the granting of McCurdy's patent and

the machine as we know it must be imagined. By the courtesy of the Kodak Company I am able to show you one of the earlier experimental forms, in which we see the machine practically ready for that manufacture on a large scale which has since resulted.

FIG. 5.



The next slide (Fig. 6) is copied from the book of instructions and shows the machine as at present made with part of the front removed to allow the interior to be seen. The apron, F, is made of ruby-tinted celluloid, of the same

FIG. 6.

material in fact as the Kodak film itself, but with a red colouring matter added. Along each edge of the apron are corrugated rubber bands which keep each coil of the helix distinct, and allow the fluid to circulate between them. The apron being rolled on the left-hand spindle, the roll of the film is put into the position shown, the black paper is inserted into the slot on the spindle, G, and is wound round it until just before the film itself begins to come off the reel. The end of the apron is then hooked on to the spindle, G, half a turn is given to the handle to secure it, the developer is poured into the right-hand receptacle, the lid is put on and the handle slightly turned. It goes stiffer and stiffer until at last the whole of the apron is on the one spindle, when turning again becomes easy. Inside the right-hand half of the machine we then have what is to all intents and purposes a very long shallow dish, the bottom of which is formed by the apron, and the sides by the corrugated rubber strips and the sides of the machine itself. This dish is coiled in a helix. On the bottom of it is the black paper and on that lies the film, face outwards of course, which is exposed to the action of the developer.

We are told to turn the handle slowly, about fifty turns a minute, until the development is complete. At the first glance we might suppose that by so doing the film is carried through the developer much in the same way as it might be in the old style of developing long lengths of films by see-sawing it through a small dish; but it is not so. There seems to be no doubt that the developer is carried round with the film except for a slight lag. That this is so, is confirmed by an experiment which shows that the development factors for exposures developed close up to the spindle G is not appreciably different from that of exposures developed right at the periphery; although, of course, were the liquid stationary and the film dragged through it, we should expect the latter to be higher, since rapid motion of the developer on the surface of a film or plate, such as can be got by violent rocking, always tends to give a higher development factor.

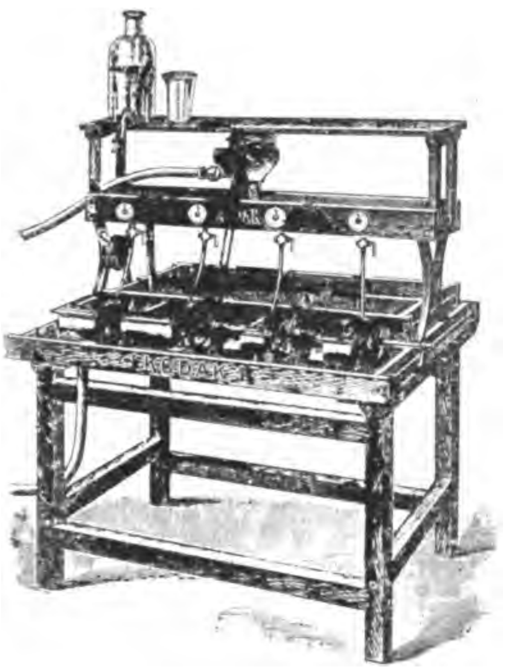
Of late years my experience has been gained entirely with a machine of this type, known as the pattern E, and taking any width of spool up to five inches. I have never had any failure with it which I could attribute to the machine, and although I have developed some hundreds of exposures in it, it is, so far as my observation goes, as good as when I had it; nor has it required any adjustment.

The next slide (Fig. 7) shows a combination of four machines with a water motor, such as is supplied for trade purposes. It is used extensively, both by Kodak, Ltd. and others for regular trade development, and is not only found to give as high a percentage of good negatives as the old plan did, but gives besides

complete immunity from light fog, finger marks, and so on, and a very great economy by the substitution of ordinary for skilled labour. Rumours of further improvements of the machine are in the air; but nothing definite has yet been announced.

The makers of the Tyma and of the Kodak developing machines both supply developers suitable for use with them. Those who use the Kodak packet developers which are pyro soda, have the advantage of knowing definitely the composition of the solution they are using, and of a "time-table" which is given in the instructions, and gets over the temperature difficulty very simply. The developer recommended is made up so that each ounce contains approximately:—

FIG. 7.



Pyro	$1\frac{3}{4}$	grains.
Anhydrous sodium sulphite	10	,,
Anhydrous sodium carbonate	7	,,

The time-table recommends developing for eight minutes at 45° Fahr., five minutes at 60° to 65° Fahr., four minutes at 70° Fahr., development not being advisable above 70° Fahr. In actual practice I find it simplest to bring the developer to 65° Fahr. by pouring it into a jug that has been warmed with hot water, if need be. It has been urged against this system that the temperature of the developer when development is finished may be very different from that which was ascertained with the thermometer before commencing. It *may*; but the objection hardly applies to ordinary usage. To get definite figures on the subject I took the temperature of the room and of the developer before and after use during the cold weather last week. The room was 55°. The developer was put into the machine at 65°, and after development was still between 63° and 64°. That was in a cold room. My developing is generally done in a room at 60° to 65°, when of course the difference would be less or would disappear altogether.

There is no need to use the formula given by the makers, of course, provided we find out how long development must be with the selected developer in order to give us the development factor desired. This can be got near enough for most people by developing a few cut films in a dish and noting the time taken for the exposures which seem to be about right to reach correct printing density, noting also the temperature. That temperature and that time will then be approximately what is required. Such a developer is the following, which I have found very suitable for Kodak films. It gives an image that is a little blacker than the pyro-soda formula:—

Pyrocatechin (Katchin)	2	grains.
Crystalised sodium carbonate	24	,,
Crystalised sodium sulphite	24	,,

The time of development with this formula, using Kodak film, and a temperature of 65° Fahr., is seven minutes.

When development with this machine is complete, the lid can be slid back, the developer poured off and replaced by water, this replaced by fixing solution, and so on in a way I need not describe. The whole of the operations can be performed in full daylight without the slightest fear of fogging the film.

I have used some of the other films on the market in the machine, and have found no difficulty in doing so, except that a gummed label or something of the kind must be employed to attach the outer end of the film to its black paper. In the case of the Wellington non-curling film, which in other respects has given me excellent negatives in this way, I have had trouble with the black paper sticking to the gelatine-coated back of the roll film; but I understand from the makers that this is having their attention.

There is one other little piece of apparatus which I have found very serviceable in connection with the developing machine, and that is Stanley's dark room clock, an example of

which is on view. It is convenient for many other photographic purposes, and is as handy a tool as I have in my dark room.

There are other pieces of apparatus which are on the market, which allow of plates being developed in the dark, such as troughs with lids and so on. Some of these have been lent by the makers and are on view. As, however, they involve no mechanical devices which do not explain themselves at a glance, I need not do more than allude to them in passing.

The Future of Time Development.

There is sound wisdom in the advice "never prophesy unless you know," and I propose to be guided by it to-night, and I will refrain from asking you to contemplate a vision of photography in twenty years' time, when all developing is done by a mechanical and not by a human "crank." I will ask you to remember, however, how great a change has come over the procedure of the photographer since 1890. It is not a change of apparatus or material so much as a change of method. One by one we are abandoning the old system, according to which we relied upon development to correct errors in exposure, and upon the eye to tell us when development was complete.

The motto for the future seems to be, "Take care of the exposure, and development will take care of itself."

Hurter and Driffield, Watkins, Wynne and others have made the problem of correct exposure far simpler than it used to be; plate and film makers are marking plates with far more definite information than the old "thirty times" or "fifty times"; and the plates themselves, thanks to improved instruments for studying emulsion making and the changes which take place during the growth of sensitiveness, are far more in accord with practical requirements. The sale of fast plates at a higher price than slow ones, such fast plates being only the slower emulsion unintentionally fogged, is inconceivable now; yet we are assured that not more than fifteen years ago it was the case. There are still some it would seem who are inclined to dispute the power of a developing machine to deal with under or over-exposure, but, with the advance in means of ascertaining what is the correct exposure, this objection, were it to have a foundation in fact—and I have endeavoured to show that it has not—would have to disappear.

Time development in its broadest sense is unassailable. The moment truth of gradation becomes all important, time development becomes a necessity; it can only be dispensed with so long as we have no means of testing the results. Skilled three-colour workers tell us that it is impossible to determine the duration of correct development with the eye. They must work by time development, quite apart from the fact that their plates are red sensitive. For studio work, where conditions are fairly uniform, something very much like time development is employed almost unconsciously. The operator who had to treat his negatives with tentative and all the other forms of development which figured so largely in the text-books of twenty years ago, might not find his methods traversed, but would certainly hear from his employers on the subject of his output.

For press work, the developing machine has already come extensively into use; it is employed, as the advertisements of its makers remind us, at the seat of war, at the Panama Canal, and elsewhere, under circumstances that would render the old-fashioned style of development impossible.

For pictorial photography, its convenience would commend it, if the truth of its results should not. One of the most gifted of photographic picture makers has said that a photographer using his camera as a means of artistic expression should no more have to think of his apparatus than a writer has to think of his pen. That degree of simplicity I fear is not attainable; but it can be approached, and a very distinct step is taken when we recognise that as far as the personal factor is concerned, our negative is completed when the exposure has been made; and it is on the recognition of that fact that time development is based.

DISCUSSION.

Mr. Chapman Jones said the author had divided the paper into two parts, in the first of which he (the speaker) did not think he had gone even far enough. We should not be content with the production of the negative, and then leave the print out of consideration. In almost all cases any error in the negative was exaggerated in the print, so that a perfect negative rarely gave a perfect print, *i.e.*, perfect as compared with the original subject. The second part of the subject was, he thought, a matter of profit and loss. The author had

represented the methods of time development as if they were all profit and no loss, and for his own part he sympathised with men like Mr. H. W. Bennett who claimed that there were distinct advantages in continuing to work on the older methods. The nett result of the profit and loss must depend on circumstances, but he was prepared to go so far as to say, that he believed there was not one man in ten thousand who would find that the nett results of using time methods of development were not profitable. He had seen people who did not know anything about photography use time developing machines; he had seen photographers use them, and had used them himself, and he believed, under ordinary circumstances, better results were obtained by developing so than by the ordinary methods. If the negatives were developed separately, some would be better, but he felt sure that the greater number would be inferior, except in a few cases where a man was particularly skilful. There were a few such men still living, who were doing work of a certain kind in which they had a great deal of practice. He would like to give one example where a positive improvement could be obtained by developing separately. If it were taken for granted that the exposures were all perfect—and they ought to be very nearly perfect under modern conditions—then it did not much matter how one developed so long as the negatives were not over or under developed. But if the exposures were not perfect, or if one did not develop completely (and he believed good photographers very rarely developed completely—*i.e.*, they did not develop out from the negative all they had put in from the exposure), there would be some negatives which might have been improved by a variation from the standard time. On the other hand he remembered very well developing a series of exposures in a "Kodak" developing machine, and thinking he knew better than the instructions. He gave them a minute extra, and afterwards wished he had not. He quite agreed that the advantage was all on the side the author had advocated, but there was another side, and there was perhaps one man in ten thousand who could take advantage of certain possibilities with regard to the time of development, and also with regard to the nature of the developer.

Mr. J. STERRY remarked that the author had spoken of there being no fog with time development. There would be no light fog because there was no light, but there might appear to be a fog simply due to a difference of exposure. Taking a plate thickly coated, which would give a correct exposure with one, two, and four seconds exposure, the result, when developing for a given length of time, must be different, and he believed that was the main reason why time development had not been taken up so rapidly as one would have expected. The only difference under the circumstances he had suggested, was that there was a fog over the whole plate, and the difference in printing would simply be a question of time. One could not altogether judge by the appearance; there would still be a visible fog which was not due to light but simply to the increased exposure. If the author had exhibited the actual negatives, an apparent difference would have been discernible in them which was not shown in the slides.

Mr. HECTOR MACLEAN congratulated the author upon the interesting and masterly way in which he had treated the subject. He was sure those present would sympathise with those gentlemen who, in the past, had been in the habit of mixing their developers with brains, and controlling their development with what he might term a kind of essence of artistic temperament. He had the pleasure of listening to Mr. Bennett's paper on the previous evening at the Royal Photographic Society, and that gentleman particularly emphasised the value which he considered he possessed in controlling the growth of his negative by ocular inspection, and also by wholesale variations in the strength of his developer. He would like the author to say whether it was possible to use the time system of development when the developer was diluted as much as Mr. Bennett said he frequently used it, *i.e.*, by the addition of eight times the amount of water usually employed under normal circumstances. When anything new was brought forward some people were inclined to imagine that everything which had preceded it was thereby entirely swept away, and it was sometimes by claiming too much that too little effect was gained by what was in the present instance a very valuable system of obtaining excellent pictures. He therefore thought that the very great importance of climatic influences in the development of the negative should be borne in mind. Everything would work smoothly if the temperature was fairly normal, but it was well to remember that questions of temperature, even with experienced workers, had brought about great disaster. For instance, negatives had, through too low temperatures, been under-developed, whereas, on the other hand, when working in the tropics, negatives had, when time alone had been used to gauge the development, been excessively over-developed.

Mr. W. THOMAS thought the subject was an eternal one, of which there was absolutely no solution. Those who believed that they could alter the results in their negatives by adopting various means were convinced of it, and gave what to them was a final answer, that not only were they convinced of it, but they had in their possession, as a result of their own labours, actual facts which demonstrated it. In fact, they could make out quite as strong a case in theory as had been made out on the other side by the author. The solution of such a matter was the actual

results produced, not in the shape of negatives, but of positives. The negative was only an intermediate stage, and whether it was fogged or clear, thin or dense, was perfectly immaterial. He did not agree with the remarks which had been made about the poor, wretched people who ought to be sympathised with. Mr. Maclean had stated that they mixed their developers with brains, which assumed the fact that they possessed brains. He did not think any sympathy was needed on one side or the other. The time was rapidly approaching, if it had not already arrived, when the question of mere length of exposure, or correct form of developer, would be perfectly immaterial, because neither by one means nor the other, nor the two together, could an absolutely correct representation and reproduction of natural objects and natural colours be produced on the plates at present in use. In considering the question of exposure and development there was a more important factor still to be taken into consideration, namely, the possibility of a present-day plate being amenable to treatment for the proper reproduction of the huge number of colours that had to be produced. If the plate was not quick and sensitive enough to enable photographers to get a full registration of some of the rays of the spectrum on the plate, no form of developer or development could possibly give a correct reproduction of it; and he hoped the attention of investigators on the subject would more and more be given to the production of a plate whose sensitiveness to the less actinic parts of the spectrum would be as far as possible raised, and at the same time its excessive sensibility to the blues and violets decreased, so that the two ends of the spectrum would be brought closely together. That was to some extent obtained at the present moment by using coloured screens, but he thought the question could not be definitely discussed as a complete whole within the mere confines of the exposure and development of the plate. He agreed with one thing in the principle described, that it would be by no means a bad plan if all beginners were simply given some form of developing apparatus, and were not allowed for a time to vary either the constitution of the developer or the time a plate or film was subjected to it, and by that means learn what was really the crux of the whole question; to give a full and ample exposure to every plate or film, because what was never on a plate no developer or form of using it could possibly put there.

Colonel ALLAN CUNNINGHAM presumed that when the author stated that the developer should not be used at a temperature of over 70° he spoke of the temperature of the developer itself, not of the air. The question, however, was one of considerable climatic difficulty. England was liable to a large range of temperature; in the States temperatures far below zero were common, while in the tropics temperatures over 100° were not unusual, and it was not easy, without ice, to cool water to a temperature of 70° when the air was over 100°. The author had made out a very strong case for time development, because there was no doubt that from a business point of view a much larger quantity of films and plates could be developed by the process than with the older method; but was it possible to get the best results artistically in that way? It seemed to him that the crux of the whole question was the exposure. If photographs were not developed for some months afterwards, one did not know whether they had been sufficiently exposed or not, and if they were then developed by the time method one had no control over the film or plate. He thought there must be many cases where it would be worth while saving an incorrectness of exposure by paying great pains to the development. For instance, one might be at a place which they would never visit again, and take some negatives of a scene which they were particularly desirous of possessing, and if one developed them mechanically the negatives might be lost, whereas if one developed them under control a result might be obtained which, though not so good as if the exposure was perfect, was still a better result than if a mechanical process of development had been used.

The CHAIRMAN said that Mr. Maclean was afraid that in hastening to the new they might be letting go something which was valuable in the old, but he thought Mr. Bailey had met that by pointing out that time development had been going on for ten years, and yet there were certainly thousands still tinkering with the developer, with their No. 1 and No. 2, with the idea that they were improving the quality of their picture, or counterbalancing over or under-exposure. If such tinkering was largely a delusion, it was of the utmost importance that those who were engaged in that practice, either in business or for pleasure, should be set upon a truer line, and that alone would be a justification for fully ventilating the subject very frequently. He admitted from his own experience that at one time he thought the variations in developing were infinite; in fact, he believed he unfortunately used that expression at one time. So they were in a certain way, but the delicate changes that were in practice, brought about by variations of developer, were not appreciable in the final print. It was the fairly wide latitude allowable in exposure, temperature, and time of development which made the machine method a really practical and useful one. He had heard a friend of his, Mr. Pringle, say that if there were no development by personal inspection in the dark room photography would have no further interest for him. He thought that was a state of mind which an enthusiast got into from long practice, because looked at from the point of view of anyone newly entering photography, the dark room could only be viewed as a discomfort and an enemy to good health. The point of view of the picture-maker had been referred to once or twice. Looking back upon his own experience, when he remembered the time he had spent

in the handling of 20-inch by 16-inch plates under circumstances of discomfort, when he might have put them into a dish, sat comfortably by them, rocked them for a time, and then taken them out and put them in the hypo, he felt that a good deal of it had been wasted. The photographer had to get some approximate idea of exposure, but even there the latitude was very wide with anything like a good plate or film. As Mr. Thomas stated, one had to think of the finished prints rather than of the intermediate stages. The photographer certainly had to get his lighting right, whether for figure, portrait, or landscape studies; he had to get every condition right, to know what he wanted, and know the means of getting it. He thought the time development system was most valuable for him, as indeed for every photographer, whether beginner or expert. There was considerable latitude in regard to temperature also, and the differences of temperature could be counteracted by altering the time given the development, as pointed out by Mr. Bayley. It seemed to him that if one had to be perfectly correct as to the exposure of the plate or film used, as to temperature, time of development, and character of developer employed, it would be very nearly as bad as having the discomfort and the unhealthiness of the dark room, but fortunately that was not so, because there was such a very wide latitude. To illustrate this, he wished to exhibit two frames, containing a series of four prints made from four negatives on a rollable film which had been developed in the developing machine for five minutes. The aperture of the lens used in every case was the same, but the plates were respectively given ½, 1, 2 and 4 seconds exposure. The only appreciable difference when the plates were developed was a variation in the general density of the negatives. If there was any variation in the gradation, it would be seen that practically the result in the print was the same. The number of seconds which each negative was given for printing on bromide paper was respectively 15, 30, 55, and 95 exposure to gas light. It was considered that about one second was the correct exposure of the subject, and most people would agree that that was slightly the best print, but the difference was so inmaterial that it showed what a wide latitude there was, and how valuable and reliable time development might be.

Mr. Bayley, in replying to Colonel Cunningham, said that whatever the temperature of the air might be in cold countries, the inhabitants did not live in rooms where the temperature was zero, and photographic developing was carried out in rooms which were heated. He could not imagine in the United States for instance, that there would be any difficulty in finding a room heated to 65°; in fact he thought there might be some difficulty in finding a room of so low a temperature. Where the temperature was 100° or over, there was a difficulty in developing at all because of the danger of immersing gelatine, which was soluble in warm water, in warm solutions; and the difficulty would apply equally to the man who developed in the dark room as to the man who developed by the time method. The difficulty could probably be obviated by the use of ice. The caution he mentioned, that the developer should not be used at a temperature over 70°, simply meant that it was not advisable to use warm solutions; but where the air was above 70°, and there were no means of getting it down to 70°, the precautions advocated in hot countries must be adopted, whatever system was used. He was not quite clear what Colonel Cunningham meant when he said that if he had only one negative of some valuable subject he would not like to entrust it to the time system of development, because it might be a failure, whereas he could save it by adopting some other method of developing. The whole purport of the paper was intended to show that if one possessed a plate of something which could never be taken again, as good a negative would be obtained by developing it in the time machine as by developing it in any other way, and the chances were it would be very much better. He would not say anything about the artistic result, because he did not see what it had to do with the particular method being discussed. Photographers were simply concerned in getting the most theoretically perfect negative, and they left it to the artists also to get as theoretically perfect or imperfect results from their negatives as they could get. Judging by the results of many artistic photographs he had seen, the actual character of the negative, or even the existence of the negative, was comparatively immaterial. One speaker had blamed him for not showing the negatives, and another for dealing with negatives rather than with prints. He thought those two objections might be put one against the other. He quite agreed that the print, or the final result, was the ultimate aim, and that, provided the right thing was obtained, it did not matter very much what the negative was like. He also agreed that if the right negative was obtained, and they were not able to get a good print from it, the system of obtaining the negative must not be blamed. In that respect he was not able to follow Mr. Chapman Jones, whom he understood to say that the theoretically perfect negative was not the negative which gave a perfect print. He was not aware of the experimental evidence on which that statement was based, and should be glad to see it. Mr. Chapman Jones had referred to certain circumstances where development was not complete. Of course if development was not complete enough to bring out all that light had done on the film as far as mere quality was concerned, any system of development would fail, but a system of time development which was not properly thought out was not one which he would justify for a moment. It was essential to any system of time development that it should bring out anything that it was possible to obtain from an under-exposed plate. If a system

of development did not give a perfect negative, and was too violent for the result obtained, then the operator was over-exposing. He did not think there was much in that, for the reason that most under exposed plates were spoilt was that, long after everything that could be got out of the plate had been obtained, the photographer had gone on strengthening his developer, thinking that possibly if he only went on long enough he might get something else. If, instead of doing that, he gave it the same development as a rightly-exposed plate, he would have the satisfaction of knowing that he had given just as much development to the plate as it would stand; he would get out all that was to be got out from it, and, at the same time, he might be confident that he had not fogged the plate through any fault of his own. He quite agreed with Mr. Sterry's remarks. There was no doubt that the essential difference between a plate which was correctly exposed, and another which was incorrectly exposed, was that there had been a fog put over the whole of the exposures, which could be subtracted when measurements were being taken, but which, when the printing was done, had to be printed through. He was sorry he did not say anything about orthochromatic photography, but he did not consider it came within the scope of the paper. Had he ventured into the thorny path of true colour reproduction in monochrome, there would not have been much room to discuss time development. The subject was very important, but it did not affect the system he had described one way or the other. By the time a plate was obtained which would give a perfect rendering in monochrome, everybody would be converted to the time method of development; in fact they would have to, because no light in which the plate was developed could leave it free from fog: some system would have to be used by which the plate was made and developed in absolute darkness.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Bayley for his valuable paper, and the meeting terminated.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

FEBRUARY 15.—"The Decline of the Country Town." By ARTHUR HENRY ANDERSON.

FEBRUARY 22.—"Some Misconceptions of Musical Pitch." By JOHN E. BORLAND. (*a*) *Visual* —due to conventional but inaccurate notation; (*b*) *Aural*—volume of tone mistaken for depth, brightness for height.

Illustrated by voices, instruments and diagrams.

MARCH 1.—"The British Art Section of the St Louis Exhibition." By ISIDORE SPIELMANN, F.S.A. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 16.—"The Indian Census of 1901." By SIR CHARLES A. ELLIOTT, K.C.S.I., LL.B. The RIGHT HON. LORD GEORGE HAMILTON, G.C.S.I., M.P., will preside.

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

APRIL 6.—"The Prospects of the Shan States." By SIR J. GEORGE SCOTT, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States.

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London.

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials." By MARION H. SPIELMANN, F.S.A. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Four Lectures.

LECTURE I.—FEBRUARY 13.—*Fundamental Principles.* — Internal combustion engines essentially air engines—Thermodynamics of air engines—Two

types, constant volume and constant pressure—Theory of compression—Efficiencies without heat or other losses—Gaseous explosions—Temperature measurements—Bunsen's method—Efficiencies with heat and other losses—Coal gas, petrol, alcohol and producer gas explosions: their differences and similarities.—Data still required.

LECTURE II.—FEBRUARY 20.—*Indicator Diagrams and Power Tests*—Diagrams from engines using coal gas, producer gas, blast furnace gas, petrol and heavy oils—Practical efficiencies and limitations in large and small motors for constant volume and constant pressure engines—Brake tests—Irregularities in diagrams, pre-ignitions, back ignitions, exhaust explosions, missed ignitions.

LECTURE III.—FEBRUARY 27.—*Examples of Internal Combustion Engines in Britain.*—Coal gas and producer gas engines, Crossley, National, Stockport—Blast furnace gas engines, Cockerill, Oechelhauser, Koerting, Crossley, National—Petrol engines, Wolsley, Liddeley, Daimler—Heavy oil engines, Deisel, Hornsby, National, Crossley.

LECTURE IV.—MARCH 6.—*Future Developments*—Suction producers—Blast furnace gas—Producer gas in power-stations—Marine gas and oil engines—Line of advance.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Dugald Clerk, "Internal Combustion Engines." (Lecture I.)

Optical, 20, Hanove-square, W., 8 p m. Mr. L. W. Phillips, "Measurement of Absorption in Tinted Glasses."

Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on the papers by Mr. A. R. Stenning and Mr. William Menzies. "Urban and Rural By-laws and suggested Amendments," and "Building By-laws in Rural Districts."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Mechanical Engineers, Storey's gate, Westminster, S.W., 8 p.m. (Graduates Lecture) Dr. J. T. Nicolson, "Results of Force Measurements with Cutting Tools, and their Application to Lathe Design."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p m. Prof. W. E. Ayrton, "Energy: American, British and Japanese."

TUESDAY, FEB. 14...Asiatic, 22, Albemarle-street, W., 3 p m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Structure and Life of Animals." (Lecture IV.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Crosbie Trench, "Alfreton Second Tunnel." 2. Mr. Dugald McLellan, "The Reconstruction of Moncreiffe Tunnel."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. P. A. Barnett, "Problems and Perils of Education in South Africa."

WEDNESDAY, FEB. 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Arthur Henry Anderson, "The Decline of the Country Town."

Meteorological, 70, Victoria street, S.W., 7½ p.m. 1. Mr. Edward Mawley, "Report on the Phenological Observations for 1904." 2. Mr. Hermann Elias and Mr. J. H. Field, "Observations made during a Balloon Ascent at Berlin, September 1, 1904." 3. Mr. J. R. Sutton, "The Winds of East London, Cape Colony."

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. A. T. de Mouilpied, "The Condensation of Anilino Acetic Esters in Presence of Sodium Alcoholate." 2. Mr. F. D. Chattaway, "Nitrogen Halogen Derivatives of the Aliphatic Diamines."

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. J. E. Stead, "Practical Micro-Metallography, with Experimental Demonstration."

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p m. Mr. J. Thompson, "The Sanitation of Southend-on-Sea."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, FEB. 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir Charles A. Elliott, "The Indian Census of 1901."

Linnean, Burlington-house, W., 8 p.m. 1. Mr. J. G. Baker, "A Revised Classification of Roses." 2. Messrs. E. G. Baker, Spencer Moore, and Dr. A. B. Rendle, "The Botany of the Anglo-German Uganda Boundary Commission."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. J. J. H. Teal, "Recent Work of the Geological Survey." (Lecture I.)

United Service Institution, Whitehall S.W., 3 pm.. Captain E. D. Swinton, "The Comfort of Troops on Active Service."

Historical. Clifford's-inn Hall, Fleet-street, E.C., 5 p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 7 p m.

Camera Club, Charing-cross-road, W.C, 8½ p.m.

Mining and Metallurgy. Geological Society's Rooms, Burlington-house, W., 8 p.m. 1. Mr. H. E. West, "Early Dry-Crushing Plants in Western Australia and the Introduction of the Filter Press." 2. Mr. Hugh F. Marriott, "Deep Borehole Surveying." 3. Messrs. A. Jarman and E. Le Gay Brereton, "Laboratory Experiments on the Use of Ammonia and its Compounds in Cyaniding Cupriferous Ores and Tailings."

FRIDAY, FEB 17...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p m., Mr. John W. Gordon, "High Power Microscopy."

North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m. Annual Meeting.

Geological, Burlington-house, W., 3 p.m. Annual Meeting.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Prof. W. E. Lilly, "The Strength of Columns."

SATURDAY, FEB. 18...Royal Institution, Albemarle-street, W., 3 p.m. Sir Alexander Mackenzie, "The Bohemian School of Music." (Lecture III.)

Journal of the Society of Arts.

No. 2,726. VOL. LIII.

FRIDAY, FEBRUARY 17, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 20, 8 p.m. (Cantor Lecture.) DUGALD CLERK, "Internal Combustion Engines." Lecture II.

TUESDAY, FEBRUARY 21, 8 p.m. (Applied Art Section.) MARION H. SPIELMANN, "The Queen Victoria Memorial as compared with other Royal Memorials Abroad."

WEDNESDAY, FEBRUARY 22, 8 p.m. (Ordinary Meeting.) JOHN E. BORLAND, "Some Misconceptions of Musical Pitch."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. DUGALD CLERK, M.Inst.C.E., delivered, on Monday evening, 13th inst., the first lecture of his course on "Internal Combustion Engines."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, February 16th; SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., in the chair.

The paper read was "The Indian Census of 1901," by SIR CHARLES A. ELLIOTT, K.C.S.I., LL.D.

The paper and report of the discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, January 31st; LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, in the chair.

The CHAIRMAN, in introducing the readers of the papers said that they were well known to the majority of those present, and those who did not know them probably knew indirectly some of their work. A few years ago it used to be a grievance amongst examiners at South Kensington and elsewhere, that students defaced their designs by very bad lettering. County Council and other schools since that time had taken up the teaching of calligraphy, and nowadays wherever there was an exhibition of arts and crafts one could be pretty sure of seeing good script, which was very largely the effect of the authors' teaching. Both Mr. Johnston and Mr. Hewitt were masters of their crafts, and he was sure their contributions would be most interesting.

The following two papers were read—

CALLIGRAPHY AND ILLUMINATION.*

BY EDWARD JOHNSTON.

THE DEVELOPMENT OF WRITING.

The development of the book-hands from the Roman alphabet, showing the growth of varied letter forms for useful or ornamental purposes, is the key to the practical study of calligraphy and illumination.

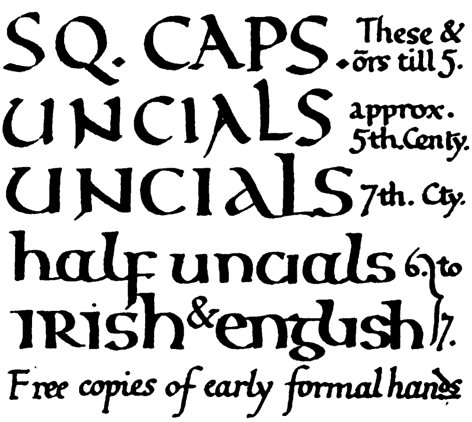
Doubtless the forms of the letters of the fine

* This paper forms a running commentary on 42 slides which were shown. I have to acknowledge the courtesy of Mr. John Hogg for permitting the use of these before their publication in book form. The seven rough diagrams here given have been since made specially to illustrate this paper.—E.J.

inscriptions in stone and the forms used in writing, acted and reacted upon each other, so that the pen, the chisel, and the brush all contributed to the development of the perfect forms of the Roman Capitals used in the beginning of the Christian era.

Formal writing may be said to begin with the "Square Capitals"; these and kindred forms were used till about the beginning of the fifth century. Though it had not yet become customary to separate the individual words, this writing—1,500 years old—is extremely legible; the vague popular accusation against the old "crabbedness and unreadableness" more truly applies to the hands of ourselves and our friends.

Fig. 1.



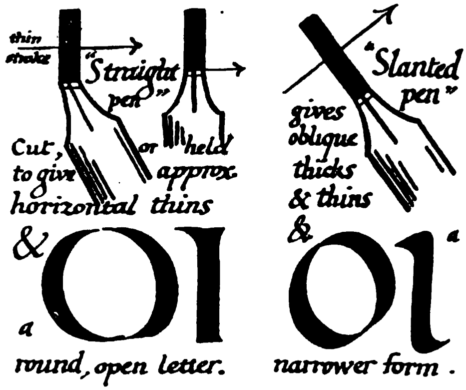
The beautifully rounded "Uncial" letter of the fifth century is a truer pen form. The "Half-" or "Semi-Uncial" writing of the sixth century is derived from mixed uncial and cursive forms.

The Cursive, or informal ordinary writing of the Roman capitals—with a stylus—produced the "Small Letters." These were adopted by the scribes and, after 200 years, were universally used for books.

The Roman missionaries brought the "Roman Half-Uncial" forms to Ireland, and the Irish missionaries brought their writing to England in the 7th century. The "Book of Kells" and the "Durham Book" are the marvellous works of the Irish and English penmen.

About this time the thin strokes of the letters became approximately horizontal, but a reveron to the earlier and easier method of holding the pen "slanted" led to the narrow and angular writing of the twelfth and succeeding centuries.

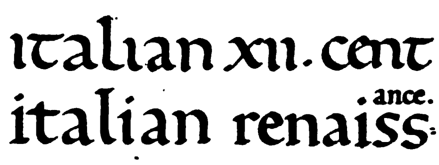
Fig. 2.



The "Caroline Hands" of the beginning of the ninth century—developed in France presumably under English influence—reformed the inferior Continental hands. Though written with a "slanted pen" it is very open and round.

In northern Europe in the course of time these fine qualities were lost and gave place to narrowness and angularity. In Italy, however, the twelfth century writing was exceedingly beautiful and round. And the Italian scribes of the Renaissance modelled their hands on such writing: the result is seen in a late fifteenth or early sixteenth century writing. The Italian printers following the scribes gave us the "Roman Small Letter" which is used to this day.

Fig. 3.



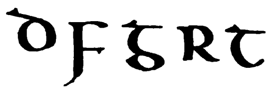
The evolution of our ordinary type letters and nearly all other important varieties—both useful and ornamental—is mainly due to the use of the pen.

Learning to Write.

In making practical use of the art of Calligraphy we may take as a model a good legible

round hand—such as the Anglo-Irish writing in the "Durham Book," and, after careful study, replace the archaic forms,* such as:

FIG. 4.



by later forms akin in feeling to the other letters.

This hand is written with a properly cut pen, which is used with the slightest possible pressure. The shape and the proportions of the pen nib, and the direction in which it moves, together produce the thins, thicks and gradated curves, and the graceful forms of proper penmanship. From such a round hand one would pass on to a more practical "slanted-pen" writing, and the accomplished penman develops naturally some sleight of hand and a characteristic manner, and so at length attains a fine, legible, and entirely personal handwriting.

An interesting proof of the power of the pen is given by taking the skeleton or "Essential Forms" of capitals and small letters—as we should make them with a pencil—and writing them with a "square cut" pen. The oblique letters (A, K, M, &c.) may be written with a "slanted pen," in order to lighten them; and the characteristic hooks, "heads" and serifs which the pen produces may be used to terminate the strokes.

The alphabet so written shows a remarkable degree of character and finish, produced entirely by the pen. A stronger and more practical form is produced by similarly using a "slanted pen."

Another kind of penmanship is seen in what we may call "semi-formal writing." This is written with a pen giving a somewhat stylographic form of letter, having no decided thicks and thins. This Italian sixteenth century example shows great rapidity, combined with beauty and legibility; it took the scribe but a little longer to write than we should take to scribble it, perhaps 10 to 15 minutes per page. The practice of such a writing might be of very practical benefit to many of us in reforming our ordinary hands.

* Unless we are writing in the Irish language which still retains these forms in the alphabet.—E.J.

ILLUMINATION.

Illumination has its beginning in the use of larger or coloured capitals to mark the commencement of books, chapters, verses and the like. Such letters are generally very different from "simple-written" forms, and may be described as "built-up" pen forms.

Great variety was introduced in the twelfth century "Versals;" and added flourishes, in another colour, were common in the thirteenth century. Line-finishings and flourishes on the ends and tails of letters accompanied the use of Versal capitals, and contributed to the growth of illumination. The decorated or decorative initial naturally became, and, I think, still remains, the central motive of the illuminator proper.

FIG. 5.

The true development of this art is most graphically sketched by Ruskin, in "Lectures on Art" (No. V.), where he says: "The pen . . . . is not only the great instrument for the finest sketching, but its right use is the foundation of the art of illumination . . . Perfect illumination is only writing made lovely; . . But to make writing itself beautiful—to make the sweep of the pen lovely—is the art of illumination." And also that, those who have acquired "a habit of deliberate, legible and lovely penmanship in their daily use of the pen . . . may next discipline their hands into the control of lines of any length, and finally, add the beauty of colour and form to the flowing of these perfect lines."

A very simple and delightful method of decorating a page of writing with pen-work is to take a few simple elements—a curve, a leaf, a circle, &c.—and build up a semi-organic pattern, as a bookbinder builds a pattern on a cover with a few stamps. The main stem springs from an initial and covers the ground with a few sweeping curves, the branches fill the corners and (built up) "flowers," &c., are placed in the larger spaces; evenly distributed leaves, stalks (drawn after the leaves), ten-

drils, &c., fill the interstices and produce a pleasant even covering. Black stems, gold leaves, and coloured flowers are used in a fifteenth century French illumination, made on these lines.

FIG. 6.

The finest and most interesting illumination, however, is that which may be produced by a good draughtsman. A more natural treatment of very delicate foliage, &c., is seen in an Italian fourteenth century MS. (in the British Museum: Addl. MS. 28841) of an unusual style.

For draughtsman - illuminators the plant forms in the old herbals, and Bewick's woodcuts are worth studying.

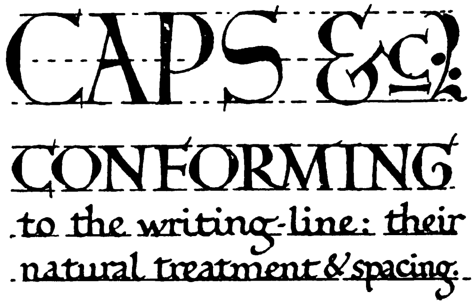
MAKING MS. BOOKS, &C.

To turn our work to practical account it is necessary to make definite things: the making of MS. books is the most instructive practice.

All good work more or less arranges itself; the size of the book (whether a folio, 4to., 8vo., &c.) may be determined by the size of the sheet of paper or skin in regular use. The margins are regularly proportioned for the comfort of the reader—wide enough but not too wide—and these partly determine the length of the writing line; for ease in reading and writing, the writing line should contain neither too few words nor too many—from four to eight words, or an average for ordinary use, of six words to the line, is suitable. This number of words means about 36 letter spaces, and so the size of the writing is determined by the number of words to the line. A reasonable distance between the writing lines determines the number of lines to the page (*i.e.*, in the space between the top and foot margins).

The writing lines are ruled throughout the book; on every page they form a proportional scale or "ready reckoner," to which the decorative capitals, &c., conform. The business part of the work—the writing—is completed, suitable spaces being left for decoration (capitals, &c.,) on the initial page and for chapter headings, &c.; the writing is then decorated.

FIG. 7.



While conforming to reasonable rules, we must preserve our freedom, one of the greatest virtues (and a more accurate naming of what is commonly admired as "spontaneity.") A text and its commentary (or other subordinate or explanatory text) may be made complimentary—a great convenience to the reader. Types of different sizes may be used in connection with illustrations, in order that the explanation may be on the same page with the picture.

CONCLUSION.

A fine title page by Holbein in a book printed at Basle shews a beautiful type—used throughout the book for headings—giving a much simpler and better effect than the majority of "specially designed" title pages.

A modern inscription in stone shows the possibilities of good lettering on foundation, memorial stones, &c.

A rather ornate treatment of a Communion service on vellum shews some ornamental possibilities of the work.

A perfectly plain brass shews some of the practical possibilities.

This paper can only briefly touch some of the divisions of a very large subject. Writing, illumination, and "lettering" offer a wide field for the ingenious and careful craftsman. The elements of the art are easily learnt by anyone, and it is easier than people suppose to make really beautiful things by taking a little pains. The practice of writing opens the way to a number of delightful occupations (to say the least), and compares in some degree with the practice of music. Above all, the educational value of penmanship is very great.

CALLIGRAPHY AND ILLUMINATION.

By Graily Hewitt.

"Illumination" is hampered by the narrowness of the conception of its scope. It has come to mean an extraneous prettiness added to writing, rather than the beautifying of writing itself; as we might fancy that by tying gay bows and ribbons to our chair legs or fireirons, and nailing up a rose here and there, we should be improving the appearance of our furniture. To be true decoration of lettering, illumination is a more serious affair, and concerns construction itself; and since the craft has lost continuity of tradition, and

Fig. 8.

suffered great degradation, any earnest practice of it needs much rudimentary knowledge of ways and means. The study of its tools and materials is no less necessary than the study of the models of past craftsmanship for help and inspiration; thus, a well-cut pen or chisel have things to teach we shall not learn from all the wonders in a museum. We can begin afresh through simple methods to attempt simple results, and come at the root of the matter. By illumination, therefore, I would understand, not the application of a dexterous scroll, or fifteenth or other century system of twiddle to a manuscript, but some wide generalisation to cover all the work of lettering, where, with dignity, discrimination, and thoroughness, the craftsman, whether with pen, brush, chisel, or printing-press, strives to give a material beauty to the words he has to present.

For illustration, I show on the screen a page, printed at the Ashendene Press, from the "Fioretti" of St. Francis. The simplicity, strength, and restraint in it are evident. Red is used in the marginal note, the initial letter and the chapter heading just above the A. The rest is black, and depends for effect upon careful selection of type, the massed evenness of its columns, its spacing, regular arrangement, and general tranquillity. But what is also notable is the inter-dependent ordering of all the means to the end, the book. The illustrator has not been content to make a picture only, but in making it has subordinated himself to this end, and employed the weight of line, the amount of detail, size and space, exactly suitable to the type he is to assist. And the beauty of the whole may be said to constitute true illumination.

Every such means, indeed, by which beauty may be given to words, are its concern: but only step by step. And we may begin to illuminate, in this sense, by making good letters on an appropriate surface with an appropriate tool. And beginning so we may expect to learn the better what beauty men have already given to them, and understand something of their possibilities and limitations, before we venture to apply any scheme of decoration of our own.

What, then, are *good* letters? And what style shall we affect? Have we the choice, any more than we have a practical choice in the matter of our clothes? And has this not been so in any century, save at epochs like the Renaissance? Our style stands evolved for us, and all there is for us to do is to make the best of it by honesty and refinement, at least until we have mastered it and have earned a right to improve upon it. And in this matter of lettering we are lucky; for our style, degraded enough may be, is after all founded upon the Italian scripts of the fifteenth century, and the magnificent early printing of the Venetians. We employ the same sort of Roman capitals, rounded small letters, and italics, or forms very closely allied. And as these meet our eyes in every newspaper we pick up we may wish them indeed better made, better spaced, better arranged; but we cannot make substitutes for them, even if we could devise better ones, without at once becoming less legible. For our eyes are accustomed to read them, and read them easily. And as

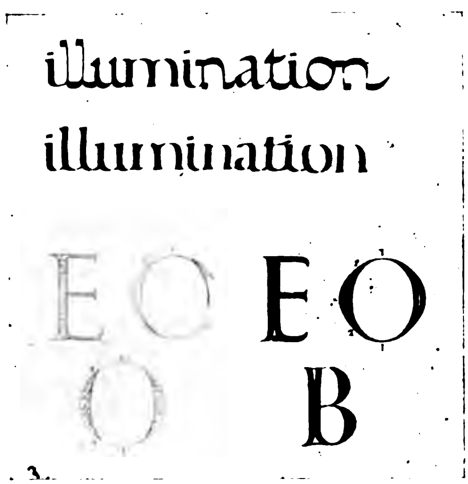
legibility is the first requisite of lettering (letters being primarily made to be read), we lay aside common-sense for the sake of artistic pride, if we attempt to create the unusual. It may be argued that, as we are the heirs of the ages, we may imitate with profit any and every example they have provided. The style we find existing, however, is surely the one *primâ facie* applicable to us; and to do otherwise than adopt it is to be re-making varieties human nature has either rejected or grown out of; and, moreover, to be foregoing the hope of proficiency with at least one of them, which continuous practice may give, while we stay to speculate and experiment with defensible alternatives. To compare great things with small, is not the charge brought against architecture that at the present day it has no style because it has so many?

How then may these Roman letters, large and small, be made as well as possible? The pen, by long and wide-spread usage, is recognisable as chief of the letter-making and modifying tools. An examination of its method, therefore, cannot but be of service, even for other or derivative methods, that their differences and the effect of these upon the letters may be appreciated.

The best aids to legibility are simplicity of form and regularity of construction. And to these elements refinement has usually added the beauty of contrast. Whether the pen's natural aptitude to make thick down strokes and thin side strokes, or our no less natural approval of thick stems and thin branches, is responsible for this is not the craftsman's concern so much as the observance of the feature, and with a nice regard for the regularity of its construction. We should at once resent as ridiculous an alphabet which proceeded as the upper one on the screen (Fig. 9) in disregard of this stem and branch feature, using contrast indeed but with no apparent regularity. It is distracting. We need to have the similar parts of the different letters made in a similar way, that their uniformity may give us peace. In the lower line such uniformity is observed. The principle is obvious enough in this instance; and yet a feeble method of making letters, especially the capitals, is responsible for its continual violation. And if the irregularity be but slight we are often at a loss to know why we do not like an alphabet, when we look at it and know we do not. It is safe to say that in this matter regularity is uniformity, and never monotony.

On the screen we have two methods of making Roman capitals. (Fig. 9.) That on the left may be called the crowquill-and-fill-in method, that on the right, the broad-pen method. In the former, the outline of the letters is drawn, and the inclosure inked in, and by it a strain is immediately put upon the drawer to measure his breadths evenly, as the pen does not help him to do this; and not only the breadths of his broad stems, but the breadths of their narrower branches. To keep these breadths even throughout the work is difficult, but if the letters are to be regular these breadths must all be similar. Besides this, the method tends to drawing by aid of a ruler, and to scamping the delicate concavity the outline of the stems should have in Roman capitals. The method's defect is more striking in the O's. For here again with no help from the pen the writer must make the gradation from extreme thickness to extreme thinness evenly four times, and, whenever a curve occurs in the work, must make that curve evenly gradated, and precisely equal to the other similar curves. He naturally flies to compasses to give him at least a circle. Yet the mathematical exactitude of a circle is perhaps undesirable for a Roman O, and if he thinks this, he must add a gradated bulge on

FIG. 9.



the outside as well as manipulate the interior increase. The strain of measuring as well as drawing results in a mechanical stiffness and wiriness, or else in irregularity and feebleness.

But if the broad-pen method is used, the tool is admitted to save all this trouble of measurement. Perhaps I need hardly point out how the stems are so measured, and the

branches also in the angular letters. Two strokes make the stem, one the branch; and, if you draw aright, the correct measurements follow equally throughout the work. It is surely as easy to draw a thick line as a thin one. In fact, it is easier; you can see better what you are doing. The disadvantage is that you cannot rub it out so easily if it goes wrong. Yet this hardly applies to work for process production, for there we can mend our mistakes pretty freely.

In the curves the advantage of the method is still more conspicuous, for, as you see, from 1 to 2 of the O, the single pen-stroke drawn aright does all the most delicate portion of the gradation from thick to thin for you, and will do this equally in every similar case. And beyond the directness and facility which the method is calculated to give with practice, that indefinitely pleasant and vigorous effect will be found passing into the work, which a convenient tool, allowed its part therein, never fails to bestow.

Another weakness in our construction of letters arises from an uncertainty we have as to their solidity. Have letters two or three dimensions?

In the early days of the Roman alphabet, letters seem to have been mere marks on a surface, with pen on papyrus or parchment, with stilus on wax, with chisel on stone. For at first chisel-cutting is no more than glorified stone-scratching. And possible solidity was not considered. Not until letters had been cut from metal and affixed to a surface do we get the notion of *literæ prominentes*, which were the forerunners of the luxurious raised inscriptions of mediæval times, and find their degraded progeny in Robinson's shop facia, where each distorted letter has a painted imitation thickness and casts an imitation shadow of an independent splendour, and all in fiercely isometric perspective to make it even more distracting. Would it not be well to free our practice of this attribution of solidity to letters where it does not exist, and to ascertain some rules for its wholesome construction in places where it may, to avoid such vulgar pitfalls?

Even in wood and stone this construction is indirect and uneconomical. For you must cut away the surface of your panel or block instead of cutting your letters, and, if you do not care to trust to luck merely, you have to consider the problem how high the letters should be raised, that in the position they are to occupy the light falling upon them may by the shadows cast assist, and not obscure them.

The very magnificence of the method, where magnificence is fitting, should warn us against its cheap and reckless application to the commonplace. And if Robinson argues that he is not concerned with good letters, but with catching customers' eyes, he may be persuaded that his name can be made to "stand out" without dishonour to a single letter,—by contrast, by isolation, by study of margins and arrangement generally.

For the arrangement of lettering with regard to its surroundings and its components is of as great importance, in its illumination, as the lettering itself. And the rules and conventions relative to the matter are natural and ascertainable. There is no artistic profundity or trade secrecy in the reasons, which forbid us to run our lettering all across an open book instead of setting it in two pages, for instance; which advise that these two pages be considered as two halves of a whole, the opening of the book, instead of as separate entities, that they may balance and help each other to present it evenly and agreeably before us, with due marginal isolation from all that may disturb our reading; which regulate the spacing out of letters and words that they may be read without hesitation; which tell us that the beginning of books, of chapters, even of paragraphs, may be pleasantly notified to us by the accentuation of larger or distinguished letters; and so on. All of which matters are the province and care of illumination, to be thorough.

But, suppose all these things duly settled to our minds with regard to an imaginary book, how may we further enhance its beauty? The simplest means of doing so are by gold and colour. Our distinguished letters may be gilded, or parts of our text which seem to claim an isolation or a prominence may be rubricated, these additions being, of course, made with no change of form or position in the lettering itself. The beauty of a mass of vermilion among the black, or of a ribbon of blue and red in a title or chapter heading, or down the capitals of the lines of poetry, is alone splendidly ornamental. The danger lies in a natural endeavour to glorify particular words rather than the page in which they occur; so that I have seen sacred writing disfigured, instead of aided, by the reverence which has set the G of God in colour through it, and, by not considering beforehand that colour mingled into black may become just rusty patchwork,

has entirely failed in the honour it hoped for.

Again, the initials and capitals may be not only coloured, but set in the margin instead of the text, hung out like flags from a wall; and this has the advantage that the ornamental effect of the unbroken page of black text is not lost sight of, as is apt to be the case where a piece is taken out of the corner or side of it to provide space for the gay letter.

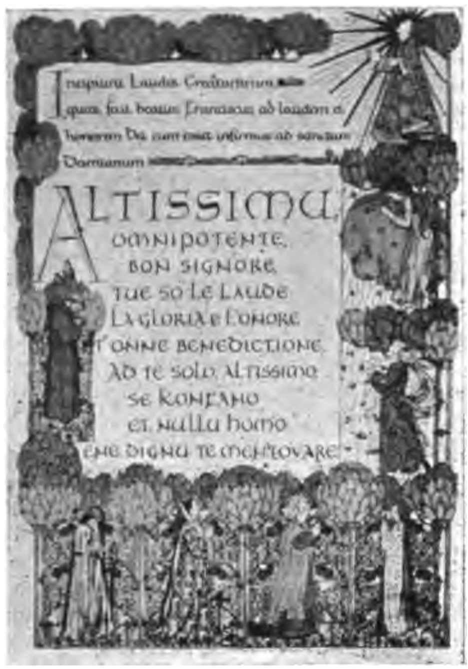
As to gold, there is no simple ornament to compare with it. Isolated or in masses, it is always splendid; and as long as the subject matter of the writing justifies so magnificent a dress, well formed letters gilded are never vulgar. But the gold must be gold, not shabby yellow; and unfortunately, with the loss of tradition, the craft has lost all confident technique in the matter. We have the old recipes for gesso and various new ones; we make our own and fail miserably; in desperation we buy preparations we know little about, and fail again. We have no certainty that our gold leaf will stick, will burnish, or in a year or two will not be a dull network of cracks. Yet until we can gild well again our illumination can never be great. For good gilding is the crown of it all. Several of us are trying to better the business, but until a sympathetic chemist brings us competent aid I do not imagine we shall progress much further than by finding out how many ways there are of not doing it.

From gold and colour our initial letters may advance yet further in decorative effect by at last giving forth buds; which buds may set out along the margin and develop into as masterful decoration as the craftsman is by this time capable of.

Here on the screen are some rough sketches of the way these letters began in the twelfth century to grow thus. And any decoration which proceeds from them so, can at least be confident that it is rooted aright with reference to its office, which is to ornament the text, springing from the place where the reason for ornament seems most naturally to arise—the initial letter. And in directing it, the plan to adopt seems most properly what I may call the *espalier* system, in which a gardener trains fruit trees. For so our growth can still be as naturalistic in detail as we may care to make it, and yet be bent to the necessities and conventional angularities of the body of text it adorns. To pretend that a flower or shrub will grow by right angles, or on the other hand to let it grow naturally in disregard of its office here, is to ignore its proprieties or our pages. The same system can be adopted where we plant its roots at the base of pages, as is conveniently done where the whole of the margins are to be filled.

As to materials, the work depending so much upon detail, and being intended to be looked right into, these should be always of the best. The parchment (for there is nothing better) should be of the finest consistent with due opaqueness. And here we are rather poorly served. Parchment is not what it was; and this seems as much the sheep's fault as

FIG. 10.



the manufacturers'. For modern farming has fattened them till they can no longer grow skins as fine and opaque as of old. And with all our french-chalking and pumice-stoning we cannot make them thin enough and pliable enough, or free them quite from grease.

Our ink must be fluid, yet quite black and glossy; our colours just as pure as possible. It is a continual astonishment that students should imagine pure colour can come out of a messy paint-box, or that the same pen, brush, and water can be used to apply them one after the other. We need so few colours that they can easily be kept entirely separate. Red, blue and green are enough; and pens are cheap. Turkey quills for stiffness, goose quills for

pliability, reed and cane pens for large work, should be kept in fair quantities, and, it is not superfluous to state, should be wiped when done with.

For gilding, the gold leaf should not be too thick. The thicker will not stick to the edges of the work, the thin sorts will not bear burnishing. A good thickness for most purposes is that of pure gold sold at about 3s. for 25 leaves.

Fig. 8 (p. 327) shows a specimen of the budded letter. An illustration of the *espalier* method spoken of for covering all the margins is seen in Fig. 10. Note how the stems ascend each side, and are trained to give off branches where required, and the trellis for the rose trees at the bottom. The sun, at the right hand top corner, is burnished gold. The photograph necessarily fails to give the lightness of the original. In particular the foliage, being covered over with gold line work to show the veins and stems of the leaves, is much gayer and brighter than the photograph suggests.

DISCUSSION.

Mr. HALSEY RICARDO thought that the interest in beautiful handwriting that had occasioned the two papers and the large audience to attend was satisfactory evidence of the growth of a general artistic feeling, concerned in seeing that the smaller details of life were made beautiful as well as the large. This represented a more healthy feeling and more capable of development than a taste for fine art complex with an indifference to the appearance of the smaller necessaries of life, which was the mark of an inartistic age. Good handwriting, being within the reach of everyone, was popular art, and to find a desire for such an ideal becoming general was a very hopeful sign. It was owing to the labours of the authors and their predecessors, such as Morris, Cobden-Sanderson, and Emery Walker, that a book, well printed in good type on good paper and well bound, could easily be bought, which was a pleasure to hold and read, and which, at the same time, fulfilled the commercial requirements of being within the reach of the most modest purse. There was still a considerable gap between the calligraphy which the authors of the papers had been illustrating and the cacography most generally current. Something of this was due to the instruments in common use, whereas the illustrations shown and described were generated from the goose quill — not a common implement to-day, and only in use amongst people who had the will as well as the leisure to sacrifice to the art of good handwriting. He thought that the modern scribe might do something—by inventing pleasant and intelligent contractions—towards helping the writer who is in a hurry. People nowaday sent each other short communications, as breathless as telegrams, which were scarcely decipherable by reason of the contractions as well as the unfinished forms of the letters. Another thing which he expected to see come within the illuminator's province, and more especially within the province of the scribes, was the writing of shorthand. Even in the way now used, with a pencil point and with no variety in the thickness of the strokes, a decorative page was obtained; but if some contrast in the density of the lines could be given, the writing might then compare with the Persian and Oriental inscriptions which made such a splendid decoration to their buildings. Lettering was a most effective form of wall decoration, and he would like to see large masses of it displayed on the walls of churches and public buildings, as well as private. With the use of shorthand, as well as lettering at full length, a great deal of useful and appropriate information could be presented on what are now blank spaces, and the buildings enriched in this way would gain in usefulness as well as beauty.

Mr. T. J. COBDEN-SANDERSON thanked the authors for their presentment of a most beautiful subject, both in its detail and in its general conception. In the first place, he wished to allude to what he might call the ideal types of which Mr. Johnston spoke at the outset, and the ways, materials and methods that had conspired to the introduction of an ideal alphabet. It must be borne in mind that alphabets were suitable to the material by means of which they were to be presented, and that there was hardly one only type in existence. They might abstract from the details of types which had been presented in the photographs, but obviously the stone-chiselled type was necessitated by the material, and by the instrument that was used in its formation. Another ideal form, the rounded form, was generated by the pen, which swept over the surface in a way that the graver could not do, and that gave rise to another type. Again, the material, even when a pen was being used, determined the type. Papyrus, being a fragile material, necessitated careful hand-writing, thin in its lines; and it was really only when vellum came into use much later that the glorious forms of calligraphy came into existence. The writer then felt, like a skater on firm ice, that he was on sure ground, and could give scope to his penmanship; he could press upon the surface and produce a broad line. Hence came the bolder alphabet, which had been illustrated by the authors. Then in later days, towards the tenth and twelfth centuries, paper and cotton were introduced, and, later still, almost too late for calligraphy, linen paper, which gave rise again to another type of writing. They had to bear in mind, in fashioning the writing of the present day, the material and instrument which were used, and must not affect an alphabet which was suitable for other circumstances. Passing on to the development of letters, many causes had been at work

in forming the alphabet. In the first place, there was the material, then the instrument and other influences which were more pertinent to the writer, such as haste and carelessness, both of which had been greatly operative in changing the characters of the alphabet. Again, convenience of space and a desire to compress much upon one page had changed the form of letter from the round form, with its broad and expanded letters, to a compressed; and there was a marked change in the early centuries from the round alphabet to the oval alphabet, in which there was height and very little breadth. Afterwards there came a reform, and the rounded form was reproduced. Associated with the craft and its materials were many delightful memories alike of lands and people. For instance, papyrus took one to Egypt, where they had obtained the beginning of the alphabet in use to-day. Vellum was chiefly associated with the rather decadent and yet noble city of Pergamos, where it was supposed not indeed, to have been invented or brought into use, but to have been more beautifully prepared. Then there were recollections of Italy and the blue Mediterranean; and later, when they came to the Christian times, monks and monasteries and their wanderings; how they went through France to Ireland and the north of England, Scotland, and Northumbria, and south again to France. It was no small craft that the authors had described; it was a world-wide vision which it was a pleasure to hand over to future generations. He rejoiced that the work was growing up again: under the authors' care it was in safe hands, and he trusted that the pupils who grew up under their influence would make the world, in that respect, more beautiful than it was at present. He hoped that the spirit of it would take possession of society as a whole, and instead of the people living a life of national strife and excitement, they would take themselves to more peaceable and beautiful pursuits.

Mr. W. Coldstream thought the subject of the papers was one of world-wide interest. As one who had lived most of his life in the East, he ventured to think that the calligraphy of some of the Oriental nations was well worth the attention of those who devoted themselves to the study of the art. The old manuscripts of Persia and India, such as MS. copies of the Quran in Arabic, the Shah Namah and Gulistan in Persian, and of some of the Hindi and Sanskrit works were often beautiful and very valuable examples of decorative writing. There was a great variety of form in the characters, and some of them were of considerable artistic value. Probably most present were familiar with the Arabic and the cursive Persian characters, but even the massive characters of the Hindi and Sanskrit, and the circular characters of some of the South Indian languages, were not without decorative effect. He often thought a little more might be done with regard to decoration by lettering in this and other European countries. It was well known that the Mahommedans had a religious objection to introducing any copy of living forms, either in sculpture or painting, and in order to make up for that loss of decorative material, the Mahommedans of Persia, Arabia, and India had devoted great attention to the development of various forms of Arabic and Persian writing, to the artistic evolution of forms of letters, and the cultivation of decorative styles, some of which were striking and effective. The Alhambra and other Mahommedan buildings in Spain were well known as beautiful examples of Saracenic architecture; and the façades, arches, and columns of those buildings were often decorated in an effective and artistic manner by the various forms of Arabic writing. The different forms of Arabic writing were distinguished by separate names, such as the Toghra, the Nastalik, and so on, names familiar to Arabic and Persian scholars. He was in entire accord with Messrs. Ricardo and Cobden-Sanderson's suggestion that a good deal more should be done in the way of decorative writing on public buildings. The nation lost a good deal by not writing up, in more or less decorative forms, facts, figures, and inscriptions of eulogy or gratitude on such buildings, a practice which if adopted would add a very valuable and interesting feature to many of them. Further, he thought the familiarising the London public with the script of the various languages spoken in different parts of the British Empire was a question of almost imperial significance. When one considered how world-wide were the dominions of Great Britain, how many peoples and tongues were the subjects of the King, he thought something more might be done in the metropolis of the Empire to familiarise the citizens with the forms of the different characters and scripts which were used by the inhabitants of the various countries over which the King-Emperor ruled. That would be consistent with Imperial policy and carry with it distinct public advantages; because it was natural that when far distant citizens from the remote ends of the Empire came to its centre, their hearts would be rejoiced, and the feeling of common citizenship would be aroused and increased, when they saw sculptured upon columns, arches, and panels on great buildings in London the familiar characters of their mother tongues.

The Chairman said the authors had given not only a dissertation upon writing and the way it was done, but a sort of paean in praise of the pen. It was delightful to hear people speak so enthusiastically of their craft. As scribes and penman the authors had naturally confined themselves almost entirely to the use of the pen. He would like to say something about calligraphy from another point of view. Mention had been made of incising stone carving, which gave the real Roman lettering, where Roman lettering was at its best, and Mr. Johnston showed a slide which he thought compared very favourably with pen work. On the other hand, Mr. Hewitt spoke of it almost sarcastically as glorified scratching. Then, glorified scratching was something very fine.

Mr. HEWITT said he did not mean to convey that it signified a difference in depth; it was only a way of marking the surface.

The CHAIRMAN went on to say that the brush was a writing tool, and it was not, like the stylus and some other tools, a thing altogether of the past. Some of the papyrus writing was done with the brush; but as far as current writing was concerned, although the brush existed still in the East, it was a thing of the past in the West. But that did not apply to decorative writing. There was still a great number of people, lithographers, for example, who preferred the brush to the pen, and who did with it some very remarkable writing, which an ordinary observer would not be able to distinguish from pen work, although it would be plain to a brushman or a penman how it was done. The authors had not said a word too much about the charm, beauty, and fascination of penmanship, and especially about the directness of the pen stroke, which deserved to be insisted upon. But it remained for someone like himself, who was not *par excellence* an expert with the pen, to mention that there were other ways of writing. Granting the pen to be the best of all tools, it was not the only one, and even if it was the best it was not necessarily the best for everyone. In all work into which art entered at all, the question of personality entered, and if someone preferred to write with a brush instead of a pen why should not he? Why should he not use it for Italic as well as for Arabic writing? He insisted on this because he felt very strongly that every decorative artist ought to be master of one kind of writing, at all events, which he could put into his work; and if that was so, surely he had a right to choose the tool he liked, and to work with it. Illumination included both pen and brush work. Personally he preferred the pen or the brush by itself, a remark which probably would not be supported by many present. One enjoyed the beauty, charm and sentiment of the old missals; but that was because one was prepared to take the goods the gods provided, and not quibble with them; it did not seem to him quite the right thing nowadays. He was inclined to think that if there was to be painted illumination in a manuscript it would be just as well to write with brush also. Mr. Hewitt said that illumination was only a kind of carrying further of beautiful writing. He entirely agreed with that view, but in that case there would be all the more reason why it should be done with the instrument employed by the writer. That was a personal opinion, and he knew it was a heresy, but he would like to know what the authors thought on the point. At any rate, he could not see logically how illumination of a manuscript by a brush could be allowable and not also writing done with a brush. There was one place where a brush was preferable, in fact, almost necessary, *i.e.*, where the scale of the writing was so big that a pen would not do it and a brush would; brushes were of all sorts of sizes; and the manipulation of a brush came easier to many who had not facility with the pen. It was quite certain there was many a decorative artist, not a penman, who could put admirable writing into his designs with a brush which he could not do with a pen, even if pen work, however well he did it, would go generally with his design. With regard to the question of gold and colour in illumination, the effect of gold was most sumptuous, there was nothing to compare with it; but partly for that reason it seemed to him there were very few occasions when it could be used. Another heresy of his was not quite to like raised gold. Anything which destroyed the flatness of the book seemed to him wrong in principle, He knew that dugesso made the gold glitter, but it looked like a remnant of barbaric ages. With regard to colour, he would like to ask Mr. Hewitt whether he quite understood him that they should confine themselves to three or four colours. He did not see the reason for that, nor did he understand why the pigments should be used quite pure just as they came from the colourman, nor why they should not be mixed together, and why a separate brush should be kept for each. He also did not see why they should, as people mostly did nowadays in illumination, base themselves entirely on the mediæval illuminations. They should be studied by all means for what they could teach, but once learnt he did not see why they should be followed. Morris certainly did not do this, and he excelled both in penmanship and illumination, and was an ardent mediævalist. Morris departed very widely from tradition both in the design and in the execution of his illuminations; in colouring he did not use the primary colours of the old illuminators. The general effect of his illuminations was that they were rather green in tone than red and blue; he did not remember much gold in Morris's work, but he might have forgotten. With regard to drawing in illumination, he sketched in his ornament, his foliage and so on quite freely, not at all like the mediæval work; in fact it looked to him very often as if he had sketched in his leaves with the brush in colour, and put the outline in afterwards, whereas the mediæval method was always to draw the outline and fill in the colour. Apropos of that Mr. Johnston had shown how to set out an ornament springing from a letter, and had said that the line should be set out first, and the leaves then sketched in, making them grow afterwards. That was quite right, but he did not like the idea of drawing stalks from the leaves to the stem. He thought it was quite right to put in the leaves first, but then he should make the stalk grow from the stem to the leaf; the draughtsmen would get more growth that way. Both he and Mr. Johnston meant exactly the same thing, and only expressed it in a rather different way; but he thought Mr. Johnston's

statement might mislead some of the students present. Apropos of a slide shown, Mr. Johnston had said something which he thought might be misinterpreted with regard to doing the thing quickly. All the disposition of the design ought to be considered carefully before the illuminator put in detail, and then it could be done as "slickly" as he pleased. But anything would not do; it all wanted great consideration. Everybody present must agree about the necessity of legibility of writing. The need was for plain writing, and it was in plain writing unadorned with flourishes that the penman showed what he could do. Even the beautiful uncial writing which had been shown was hardly familiar enough to many people quite to go down with them. But there was a use for lettering of a more ornamental kind than that which had chiefly been referred to. Attention had been called to the beautiful Arabic writing, but the Arabs were allowed very much greater freedom with their lettering than the British philistine would allow present day artists. He wanted everything terribly plain. Lettering ought to be introduced a good deal more into decoration than it was, but it could not be done until people allowed them a little more liberty. He was not arguing against anything that had been said, but simply wished to point out that there was a form of calligraphy on which it remained for somebody else to speak, and he was hoping that what he had said on the subject would draw the authors to say something more. Mr. Ricardo had referred to penmanship, and the authors had insisted upon the quill. He admitted that it was a beautiful and a sympathetic instrument to write with, but there was at least one objection to it, namely, that the cutting of a quill was an art in itself, and one in connection with which the artist was apt to be impatient. It was not altogether unreasonable for a man to prefer an instrument which would not fail him at a critical moment, which he could rely upon, and which would last, not for a line or two, but for the writing of a volume if need be. This was an age of steel pens, gold pens, and fountain pens. There was an advantage in having a pen which was not one minute overflowing and the next minute dry; the fountain pen had been a boon and a blessing to men. The misfortune was it spoiled them for other pens. The nib in common use was not made for calligraphy, but there seemed to be no reason why, if scribes insisted upon having their pens made in a particular way, they should not be of the right "cut," and even if they fell short of some of the qualities of a quill they would have qualities of their own which made up for that. It was not to be supposed that manufacturers would readily, if ever, be able to supply them with a nib which would satisfy enthusiasts of the quill, but he thought such a pen as he had suggested would tempt people to write beautifully where now the quill deterred them. We lived, after all, in the twentieth century. In conclusion, he proposed a very cordial vote of thanks to Messrs. Johnston and Hewitt for their valuable papers.

The resolution of thanks was put, and carried unanimously.

Mr. JOHNSTON, in reply, said that he was in almost entire agreement with the supplement to Mr. Hewitt's and his own paper which the various speakers had given. The whole subject was really a question of time. Being compelled by the shortness of time to give merely the "headings" of a very large subject, he spoke of what he knew best, and, as he did not know much about stone work, brush work, and the like, he did not refer to them. Two or three speakers had referred to the quill. The great virtue of the quill pen was that it could be cut to suit one's hand, and, as everybody knew, no two hands were just alike. Most truly was it an art to cut a quill pen, but once it was cut it would make the letters for the writer, who had no further trouble. With regard to the use of a metal pen, it was just possible that a steel pen might be made, but steel pens had not that beautiful feeling and elasticity. The great difficulty would be to get the requisite slant and shape of the nib, and probably one writer would find he was always digging the pen into the paper, and another would find he could make only part of the nib touch. It was always possible to fit the quill to one's hand and the work required to be done. Something might be done with a gold pen, in fact, he had actually tried a gold fountain pen, sacrificing half a guinea to the experiment. He found that he could write four times as much without sharpening the nib, but that it took him half-an-hour to sharpen the nib when it got blunt. He went to the Swan Fountain Pen Company, who said they would make a nib for him, only it would have to be made in New York, and he would have to pay 9s. for each nib, and he must take a dozen of them, and it would take four months to get them over, so he went back to the humble quill. Perhaps it was hardly right for a mere penman to speak on the question of contractions. Contractions were certainly most useful in mediæval times, and he only wished they could be used now. But he did not think penmen would start the innovation; perhaps the Society of Arts might use its influence in that direction. Mr. Sanderson had referred to the various forms of letters, and stated that there was no specially perfect one, but that each was fitted to its use. Of course he was quite unable to refer to the innumerable perfect forms of letters which had been used; he only referred to the kind which he had been constantly working on himself. Most certainly the material, the instrument, the haste, even the carelessness of the early Roman scribblers on wax tablets, and various other things all contributed to various perfect forms. He did not claim for a moment that the pen gave them everything, but the pen was the one great instrument from which they could get something really definite; it would not let one go wrong, and therein lay its great

educational value. Again, everybody could use pen, ink and paper. Very few people at the present day who lived, say, in a modern flat, could bring in a tombstone and chisels and practice cutting letters in that way; but he thought much could be done by casting little plaster of Paris slabs, and, before the plaster had got so hard that it would chip, cutting inscriptions on them. Some very beautiful work might be turned out in that way; but that would not be strictly practising the chisel form of letter, which required a chisel and mallet and real, practical slab of stone. Oriental calligraphy was exceedingly beautiful, but it was hardly practical enough for modern requirements, considering the terrific haste with which all subjects had to be attacked. Its value might be regarded as more ornamental than useful. Moreover, it did not agree with the Roman letters, which must be adhered to in some shape or other. The Chairman had said something about carefully debating how forms should be written and then working as "slickly" as possible. He entirely agreed with those remarks, but he thought that the early illuminators did not do much as a rule of that careful debating, because they had tradition at their backs, whereas artists at the present day, not having tradition, must naturally proceed with more care, not to say anxiety. He felt most strongly that while they might give all the care and almost painful debating to how work should be performed, especially when it was really great and important work, when it actually came to the doing of the work the quicker it was done the better. As a general rule, the quicker the writing the better; the more direct the work the more absolutely natural and free from artificiality. He very much objected to the habit possessed by a great many students of under-laying their work with a substratum of sketching in pencil. All that debating should be done aside. The student should have made up his mind and screwed up his courage to the sticking place, and *then* get the work done as quickly as he could. It would be a very great pleasure to him if the Society of Arts would allow him, once a week, to tell such an audience a little about what interested him in the kind of work under discussion, but he had only been able to summarise a few points of interest. All that he had said—and he believed that he could also speak for Mr. Hewitt—had to be taken in the sense that *there was a regular way of dealing with regular occasions, and a special treatment had to be adopted on special occasions*, therefore, when it might be thought that they were rather too restrained and had held back from one possibility and another, they only meant that, in the ordinary way, with a view to ordinary legibility, such and such proceedings would be adopted; but, on special occasions, there was no liberty which he would deny the scribe or letter maker.

Mr. HEWITT, in reply, said that the Chairman was an advocate of not mixing the methods of pen and brush work. He humbly agreed with Mr. Day up to almost the end of his remarks, because he thought that if in the process of an illumination one came to a point at which one wanted to spread colour over a surface, it was uneconomical, indirect and inadvisable to use the pen instead of spreading the surface at once with colour from a brush. The remark not only applied to laying in a broad background, but even putting in colour on a large leaf. Apart from that, he thought one was much better advised to keep to one tool; and the students in the classes did confine themselves to one tool, the pen. In the slides shown all the letters were pen letters, with the exception of the final slide, the illuminated part of which was done with a brush. He hoped, therefore, that he would not be accused of mixing up their methods.

The CHAIRMAN asked if Mr. Hewitt would have had any objection to the lettering in the last slide shown being done with a brush if the artist had been so disposed.

Mr. HEWITT replied in the affirmative, for the reason that the brush was such a very awkward instrument. The pen, on the other hand, was a firm instrument, which measured its own pressure. The writer only touched the paper with his pen, and it would keep the same spread of point, and so give a broad downward stroke with equal thickness without any effort. But a brush was very elastic, and was inclined to spread, so that as a line was drawn down it would spread out according to the pressure applied.

The CHAIRMAN remarked that anyone who was facile with the brush could draw a line as straight as if he were using a ruler.

Mr. HEWITT replied that all his remarks naturally referred to the student and the beginner. He particularly emphasised that in his recommendations as to the purity of colour. He almost thought for a moment that the Chairman could never have seen a student working with water, in which flowers had been kept for a week, with a brush which had been used for indigo, and a pen which had ink in it, trying to rubricate with pure vermilion. He only intended to advocate intense care with all materials.

Mr. CHARLES T. JACOBI (of the Chiswick Press) writes:—The two papers read on February 2nd last by Mr. Johnston and Mr. Graily Hewitt respectively on "Calligraphy and Illumination" were admirable in each case, and I was much interested in the slides shown, some of which were I confess a revelation—especially some of those diagrams tracing the evolution of the various forms of letters, as also were the drawings of the different pens and tools used by the modern exponents of what may be considered almost lost arts. I was sorry that I had to leave early and thus missed the opportunity of hearing the discussion

bearing on these two important and relative subjects. As a typographer I acknowledge that the more I see of the old forms of the alphabets the more I am convinced that if the creators of our modern founts of type were to make a greater study of these examples of letterings, and also if our present-day printers were more thoroughly to grasp the general principles which influenced the writing and planning out of the early manuscript books and the first printed volumes, we should I am sure more nearly approach what we might consider the ideal book, and at the same time we should be less inundated with specimens of what may be termed *l'art nouveau* in alphabets. In expressing such opinions I need only say that I am referring more particularly to those volumes which necessitate some amount of artistic treatment, but there is no real reason why the old traditions should not apply more or less to the ordinary run of book-printing, and I would yet go a step further and submit that such traditions should generally influence the whole art of printing. But, alas, commercial considerations prevail too much in this age of cheap literature, and it will require a very great effort to eliminate what is bad in type characters, and to restore those forms which may be considered as being more conventional in their construction.

TENTH ORDINARY MEETING.

Wednesday, February 15, 1905; ROBERT KAYE GRAY, M.Inst.E.E., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Barratt, Reginald, A.R.W.S., Arts Club, 40, Dover-street, Piccadilly, W.
Beckett, Henry Barron, Mailla, The Green, Wimbledon.
Bertram, Henry, 1a, Cooks-road, Stratford, E.
Bonnett, Charles, Messrs. F. and C. Osler, Hornby-road, Bombay, India.
Brincker, John Augustus Herman, M.B., B.S., M.R.C.S., the Borough Hospital, Croydon,
Buck, Edward Clarke, Assistant City Engineer, Pretoria, Transvaal, South Africa.
Casey, Mark Patrick, Municipal Engineer, Lucknow, India.
Crosse, L. Arthur, J.P., R.M. Office, Nqutu, Zululand, Natal, South Africa.
Densham, Sidney Charles, 152, Adelaide-road, N.W.
Johnson, Charles Grove, F.R.I.B.A., Apartado 610, Mexico City, Mexico.
Lisbôa, Miguel Arrojado Ribeiro, M.Am.I.M.E., Rua Costa Gama, Villa Japurá, Petropolis, Rio de Janeiro, Brazil, South America.
Perry, George A., 13, Carlton-road, New Southgate, N.
Redwood, Iltyd I., Bantry-house, Belvedere, Kent.
Sparrow, Reginald George, Lenton-avenue, The Park, Nottingham.
Vidyasagar, Panjabbhudana Pandit Bulakirama Sastri, M.R.A.S., Mayo College, Ajmer, Rajputâna, India.

The following candidates were ballotted for and duly elected members of the Society:—

Ahrlé, F. H. C., 82, Cavendish-road, Harringay, N.
Basden, Rev. George Thomas, B.A., Church Missionary Society, Onitsha, Southern Nigeria, West Africa, and 112, Caversham-road, Reading, Berks.
Black, Captain John Cameron, A.M.I.N.A., The Scottish Shipmasters' and Officers' Association, 128, Hope-street, Glasgow.
Doe, Austin, 42, Claremont-road, Forest-gate, Essex.
Gyles, Nathan, 8, Young-street, Doncaster, Yorkshire.
Hasluck, Paul N., "Ebor," Redhill, Surrey.
Heath, Henry, 2, St. Swithin-street, Worcester.
Kelly, Major Arthur D. D., Weston, Duleek, Co. Meath, Ireland.
Leggatt, Mrs. E. O., 15, Savoy-court, Strand, W.C.
Macfadyen, John Beith, 65, Apollo-street, Bombay, India.
Mackenzie, Alexander, 19, Greenhill-gardens, Edinburgh.
Robertson, Duncan, Forres-park, Trinidad, West Indies.
Skinner, George, A.M.I.Mech.E., 19, Russell-street, Bolton.
Smith, Vincent, Sheffield-road, Chesterfield.

The paper read was—

THE DECLINE OF THE COUNTRY TOWN.

By ARTHUR HENRY ANDERSON.

There are probably few people possessing any extended acquaintance with the rural districts of England who cannot, from their own experience, bear witness to signs of decay in some one or more of the older and smaller towns of the country. Almost everyone must be familiar not only with single instances of declining towns, but also with the special causes to which decay may be attributable. But though it is true that in this limited fashion most people are acquainted with the spectacle, it is no less true that there is an almost total ignorance as to the real extent and gravity of

a melancholy feature of the modern shifting of population. It is a remarkable fact that in every county the smaller towns are declining—in numbers and to a degree quite surprising. What is equally remarkable, however, is that this important fact has not yet been realised by the country at large.

In saying this, I am not losing sight of the extraordinary amount of attention bestowed upon rural problems at the present time. It is, perhaps, only natural that the period following the publication of the census results should witness a revival of interest in all such matters, and the suggested alterations in our fiscal policy have only served to augment that interest. In every direction the problems suggested by "the rural exodus,"—the many questions of rural depopulation—are being discussed with an intensity and liveliness of conviction that indicate a general recognition of their importance. In political speeches, in reviews and leading articles, in newspaper correspondence, at meetings and conferences, the many aspects of this wide and vital question have been discussed by the expert and the layman. Though there may be wide diversities of opinion as to the significance of the facts, and as to the remedies proposed, there is no room for difference as to the facts themselves, that the depletion of the villages is a process that nothing seems able to arrest. In view of this widespread knowledge of the depopulation of agricultural districts it seems perhaps not a little surprising that concerning a subject closely related—though in many respects quite independent—the general public should be almost wholly ignorant.

The reason for this ignorance is to be found largely, I think, in the form of the census returns. In many respects the reports of the Registrar-General are of course beyond praise. They are admirable in their comprehensiveness. They supply, in a multiplicity of tables, a mass of detailed information of the highest value, but curiously enough there is one point of really national importance concerning which information is not tabulated or summarised. In the tables of population for urban and rural districts comparison with the previous enumeration is, of course, supplied, and the respective increase or decrease shown. In the tables of aggregates, however, the total decreases do not appear, and in the summaries affording comparison with the preceding census the net result of the variations is alone disclosed. For purposes of convenience, the towns are classified into groups according to their population. In each class the Census of 1901 shows an increase, varying from 23·15 per cent. in towns with a population of 50,000—100,000, to 4·6 per cent. in towns with a population of less than 3,000. But, as in these tables the increasing and decreasing towns are taken together, the resulting total increase is merely the balance of increases over decreases. It is obvious that the importance of the results must depend upon the respective proportions of increasing or diminishing units. This is exactly where the census returns fail to present the true state of affairs. Indeed, the tables serve to mask the real condition, which can only be ascertained at the cost of considerable trouble in analysis and collation. Turning aside for a moment from our main purpose, we can realise the extent to which this method of presentment obscures the facts by examination of the tables of population of the rural districts. Out of 666 districts, no less than 421 (or 63·21 per cent.) show a diminution as compared with 1891, yet the net result of the figures is an increase on the whole class of 2·9 per cent. The value of such an increase must of necessity be very materially affected according as it represents a fairly general rise of population throughout the whole area, or large increases in comparatively few districts outweighing decreases in many districts. As a matter of fact the latter is the case, though there is nothing in the summaries to suggest this, and it is only brought to light by a closer examination of the detailed tables. Thus one discovers—what is really the case—that rural districts bordering upon large towns are in the main increasing, while exclusively rural districts are declining. Though this does not affect our present enquiry as a fact, it illustrates the method by which certain aspects of the census figures are needlessly obscured.

Coming now particularly to the towns, the following tables will show how entirely the official presentment omits the point of importance to which I am drawing attention.

Table No. I. is the summary of the population of urban districts as given in the preliminary report.* Table II. supplies information which is, of course, obtained from the census returns, but which is nowhere therein presented in tabular form. In preparing this table I have

* The summarised figures throughout are taken from the preliminary report, where they are more conveniently grouped. Although the figures are liable to correction in the completed county returns, the alterations are infinitesimal and do not affect the result.

altered the division of the classes, showing separately the towns with populations between 5,000 and 10,000, and between 2,000 and 5,000. This sub-division seems to afford a fairer view of the matter, and as places with a population below 2,000 can hardly be considered as towns, they are left out of account.

TABLE I.

Urban Districts with population of :—	No. of Districts.	Aggregate Population.		Mean percentage of increase.
		1891.	1901.	
250,000 & upwds	9	7,293,005	7,972,790	9·32
100,000–250,000	24	2,987,836	3,517,912	17·74
50,000–100,000	42	2,448,704	3,015,571	23·15
20,000 – 50,000	141	3,683,501	4,433,823	20·37
10,000 – 20,000	219	2,538,281	3,006,280	18·44
3.000 – 10,000	472	2,396,204	2,693,230	12 40
Under 3,000	215	396,446	414,664	4 60

TABLE II.

Urban Districts with population of :—	No. of districts.	No of districts showing decreasing population.	Per cent. of decrease.	
			In Nos of districts	In population.
250,000 & upwds.	9	—	—	—
100,000–250,000	24	—	—	—
50,000–100,000	42	2	4·76	1·65
20,000 – 50,000	141	10	7·09	3 94
10,000 – 20,000	219	21	9·59	3·58
5,000 – 10,000	271	40	14·76	5·05
2,000 – 5,000	351	114	32·48	5·74

A comparison of these tables quickly brings to light important points of difference. The official table is, at first sight, a very encouraging document. In every class there is an increase—in all classes but one, a large increase. The natural assumption is that all is well with our towns; that there is a satisfactory general increase. How little this assumption would be justified is shown by the second table, which reveals the astonishing facts that:—Of towns with a population of 10,000–20,000, *one in ten is decreasing.* Of towns with a population of 5,000 - 10,000, *one in seven is decreasing.* Of towns with a population of 2,000 - 5,000, *one in three is decreasing*; and 187 towns with populations varying from 2,000 to more than 50,000, had declined in population in the decade ending 1901. The decrease in many cases is small, but in the aggregate it is a serious item. Its proportion can perhaps best be realised by calculating the effect upon the total population of a corresponding decrease all round. Instead of an increase in England and Wales of more than three and a-half millions, the Registrar-General would have had to report a decrease of one and a-half millions in the decade ending 1901.

It is clear, of course, that this represents at most but a shifting of the population. These figures demonstrate, however, that the smaller towns are now feeling, with the villages and hamlets, the terrible suction of the great cities. They suggest that occasional instances of decaying towns, such as come within the experience of all who know the country, are no mere isolated cases, but that they fall into line as part of a movement that seems to threaten all of our smaller towns, and that has already affected almost every county in the kingdom. It seems hardly too much to say that the complete elimination of the small country town is threatened, and the future of these little local centres seems bleak indeed. The remarkable feature is that of this astonishing state of things the census reports should take practically no heed, and that the collation of the details necessary for its presentation should be left untouched. Yet in many of these towns decreases have been registered in three or four successive enumerations, and in other cases where there is not this continuous decrease, the figures for 1901 are the lowest recorded within a period of thirty years.

When the character of the towns involved is taken into account, the matter becomes almost more serious, for figuring in this list are the names of places that have borne a gallant part in our long and chequered history. Cathedral cities and county towns, seaports famous in the past, centres of agriculture and of local industry, towns full of ancient memories, still cherishing visible reminders of past glory, towns famous in literature and history, and those that have been illumined by their connection with some national hero—all of these appear in the long and melancholy list. Here are a few of them—old towns all. Chosen almost at haphazard they stand as towns that have sturdily played their part in the rough-and-tumble sport of the centuries, only to show signs of failing before the more unkindly pressure of the modern spirit. There is Launceston, in the far West; Tavistock, that gave to England in her hour of peril, the admiral who, "nor devil nor Spaniard

feared," and returned as her member the first great leader of the House of Commons; Crediton, seat of a Saxon bishopric; Glastonbury, the town of ancient ruins among the apple-orchards; Shaftesbury, throned on its eyrie, far above the fair vales of Wessex, and linked imperishably with the work of a modern master of literature; Blandford, with its long roll of honoured sons; Bradford-on-Avon, the tiny town that has yielded its old industrial fame to its northern namesake, and lives among its memories of the past; Tenterden, in Kent, with its ancient privileges of the Cinque Ports; Stroud, the town of the Cotswolds, with an Elizabethan Town Hall; Chepstow, where the ruins of Fitz Osbern's mighty castle still guard the junction of Wye with Severn; Monmouth, the Saxon stronghold, whose very appearance to-day is almost of the middle ages, proud of its honour as birthplace of the great Henry V.: in the East:—Ely, the jewel of the fens; Huntingdon and Godmanchester, the twin-boroughs that join hands across the sedgy Ouse, in whose streets the great Protector played—if he ever played at all—in his schooldays; Stamford, town of many churches and centre of scholastic life in medieval days; on the Welch marches:—Flint, whose keep still guards the Dee, as it did in those far-away days when Percy of Northumberland there betrayed Richard II.; and so on to those northern heights where the ruins of Richmond—"the warder silent on the hill"—front the glorious dales of Yorkshire. All of these, and they are but a few of many, have been towns of importance in their day. Almost all of them have been Parliamentary boroughs until recent times. Now they seem to stand as mute reminders that the amazing development of city life, consequent upon the industrial expansion of the nineteenth century, is altering the whole economy of our country. From broad acres and fertile valleys, from village and farmstead, the great cities have drawn their toll of recruits. It would seem that already the same process of absorption is depleting our smaller towns, and the figures here submitted seem to confirm the fears of those who hold that the population of the future is likely to be confined almost exclusively to cities. At all events here are the signs of a tendency that suggests a future state with a sparsely-peopled countryside as one extreme and huge aggregations of humanity as the other, and lacking the connecting links so happily supplied at present by the quiet old country towns.

Here then are the facts. It can hardly be other than a surprising and disquieting circumstance that so large a poportion of our smaller towns should be diminishing in population, many of them to a serious extent. While it is probably true, as I suggested at the outset, that everyone can recall from his own experience some single instance of a declining town, it is hardly conceivable that there is any general knowledge of the fact that so many as 165 English towns with populations varying from 2,000 to 20,000, are on the down-grade. But though this is the case it would be foolish to generalise as to the causes of decay. If some machinery were brought into play that could elicit from persons competent to judge, an authoritative opinion as to the cause or causes of decadence in every instance, it would almost certainly be found that in no two cases would the reasons offered be identical, and for this if on no other ground generalisation would be absurd. But it is almost equally certain that out of the clash of divergent opinions there would emerge certain clear causes common to many instances. Indeed, it is hardly too much to claim that certain laws applicable to groups of towns might be found to be tolerably stable in their operation. The question thus arises whether it is not desirable to set on foot some national inquiry for the consideration of this important matter in all its bearings. It is no obscure or trivial circumstance: it is rather matter for national concern.

This suggestion is reinforced by a knowledge of the many things that are bound up with the main question. It requires but little thought to perceive that certain forces are in operation to produce this state of affairs in definite instances, and as little to perceive that remedial measures must conform to certain conditions; but it is quite clear that, as enquiry came to be pressed, unsuspected relations would flash into light; the interdependence of this great question and others of no less gravity would gradually be realised. It is highly important, therefore, that any enquiry to be successful should be comprehensive and authoritative.

As an instance of the questions that are inextricably involved with this, one may mention the general question of railways and road traffic. There are many instances of arrested growth because a town has been left aside by the railway, while, on the contrary, mere villages have developed astonishingly as soon as they have been brought by the

railway into closer connection with the industrial life of the kingdom. These opposing influences do not, however, represent the whole of the power of railways, and it is by no means an uncommon thing to hear the suggestion seriously put forward—especially in country districts—that the coming of the railway has been the precursor of decay; that convenience of access to larger towns has served, not to bring prosperity, but to divert business. Thus while amid these varying opinions, it is futile to dogmatise as to degree, it is certain that the questions of railway expansion and, the shifting of population are most intimately related.

Following up this idea it will be seen that the present forms an appropriate time for enquiry on account of the recent development of light railways. Since the passing of the Light Railways Act of 1896, many supplementary lines have come into existence. Some, at least, have justified their creation, and though there may be as yet hardly sufficient evidence in the success of existing lines to justify private enterprise in netting the country with light railways, yet there does arise the question as to whether the opening up of fresh channels of business in purely rural districts, would not bring about the revival of life in those towns favourably situated as centres of local life and interchange, a position at present denied to them because they lack that facility of communication vital to prosperity in these days. It may fairly be urged in objection to this view, that practically all the decaying towns are even now reached by the railway. That is true, but in many cases these towns represent the termination of a railway. Instead of being themselves the centre of a nervous system, they are the nerve-tips only, and the position might conceivably be vastly different if they were drawing in life instead of being merely drawn upon.

Again the question of the future of our great trunk roads in connection with the development of the motor-car must obviously have a great effect, one way or another, on the distribution of population. Even those who know most about the great change in locomotion are reluctant to express any opinion as to the direction in which the development will exercise its tremendous influence. But most assuredly these influences, whatever form they may eventually take, are bound to affect very materially in some form or other the distribution of our population, and in that respect they establish their right to be treated in relation with the question of our diminishing towns. So, too, with the development of electric tramways, which seems to be proceeding along the lines of linking together town with town. It is impossible to forecast the exact future of this form of transport, but it is easy to see that it will have a great bearing upon the general question of the ultimate settlement of population.

But if these are matters whose relation to the specific question though certain are yet somewhat obscure in their ramifications, there are at least two matters of quite direct connection and importance that might well occupy attention in any such investigation as I have suggested. Without in any way reverting to such measures as are frankly protective in their operation it is surely possible to bring about a greater correspondence between needs and opportunities in the matter of particular industries. The modern tendency to remove some classes of manufacturing businesses outside the radius of great cities is in many respects beneficial. This tendency has operated to revive the prosperity of certain towns, without in any way impairing their amenity. There are industries that are not dependent upon a position within one of the large cities, trades that can be more heathily and profitably carried on in smaller towns, and the removal does by no means imply the introduction into quiet country towns of the worst features of city life. Here there is a definite line of enquiry that could hardly fail of profitable results for such an investigation as I have shadowed forth.

But there is yet another aspect of the case that in one respect at least is more urgent than those already mentioned. It is just in the small towns of England that we find the fullest material evidence of the past history of the country. With but few exceptions the larger cities and towns have come to present a wholly modern appearance. This was of course inevitable. The demands of traffic and industry are imperative. Where modern claims and ancient interests clash, it is but rarely that the latter can be considered. Therefore there has been in the last century or so, as an inevitable accompaniment of expanding city life, an enormous destruction of ancient buildings. As a consequence, it is to the smaller towns that we must turn for those material records that enable us to reconstruct the life of the past and to understand its bearing on our history. The names of towns mentioned earlier in this paper as specific instances illustrate

my meaning. By reason of their position in the past and of their corporate entity, they have been adorned with many buildings of significance and interest. Because the towns have not kept pace with the march of modern development, they have been enabled to retain the buildings that in greater cities become an anachronism and an obstacle to growth. It is just in these smaller towns then that we find in abundance the great church establishments, abbeys, priories, nunneries, churches, hospitals, schools, shrines, guest-houses and tithe-barns, and the finest surviving examples of public and domestic architecture—palaces, castles, guildhalls, town gates, fragments of walls, market halls and market crosses, manor-houses, inns, bridges, and mills. But, while these relics of the past have survived the dangers incident to city life, they seem to be threatened with another danger no less grave. If, as seems likely to be the case, many of the towns most richly endowed with ancient memorials, continue to decrease decade by decade, is there not a very real danger that waning prosperity and diminishing population may lead in time to inability properly to safeguard the invaluable treasures of these towns? This may arise not alone from such a lack of funds as might follow commercial decay, but also from the subtle workings of those feelings of hopelessness engendered in whole populations by a perpetual fight against dwindling opportunities and accumulated misfortune. Of all the dangers arising from the presence of large numbers of declining towns this is, in one respect, the most important. It is so because any injury caused by neglect of the old buildings is irreparable. Once damaged, they can never be restored to their original condition. Once destroyed, they can never be replaced, and this I regard as one of the strongest arguments in support of a national enquiry into the wide questions raised by the spectacle of so many declining towns. I think it is also clear that the work to be done is of such a character that it is worthy to occupy the attention of the ablest men of the day. Royal Commissions have often been appointed to investigate matters less wide in their bearings, less important to the welfare of the State, and it hardly seems too much to claim that here is a subject that calls for the patient investigation and authoritative report of a specially appointed commission. There is one respect, at least, in which such a Commission would find itself favourably situated as compared with a similar body dealing with the depopulation of the villages. With regard to the latter there is a melancholy agreement among the chief authorities on this subject, that even if the tide of population could again be turned towards the villages, the housing question would form an almost insuperable barrier. It seems impossible to build cottages in consonance with present-day standards that can be made to pay for their erection out of the scanty sum available for rent from agricultural wages. But in the towns this difficulty is not an insurmountable one. The return even in the smaller towns is such as always to ensure the erection of sufficient houses to meet the demands of any increase in the population. Such a Commission would start, therefore, with one very important point in its favour, and whatever might be the result of its deliberations or the measure of its success it could not fail to secure an amount of information that would be of incalculable benefit to the country and of illumination for the problems of the future.

If, unmoved by practical considerations, the nation should take no steps to arrest a decay that seems to be settling down into a prominent feature of our national life, then those who love the country best can but give expression to an unavailing regret. From the sentimental point of view it is only possible to understand the position of the country town by imagining the English landscape bereft of the little towns. It would be to withdraw from our fairest views one of the most delightful elements of beauty. Of all the sons of Britain sent out across the seas to labour under alien skies there can be few to whom almost the dearest thing in retrospect is not their memory of some loved old town, and there can be none save those born of the city—most hateful of fates—who have never experienced the kindly associations that cluster round the country towns. Nowhere else in the wide world have the little towns the same sense of enduring identity with the landscape. In their peace and charm, in their attraction and beauty, we find a haunting—a perennial interest. In all the diversity of English landscape, they take their place unchallenged. Framed and fashioned out of the hills around, coloured and weathered by the winds that sweep the insentient earth, they stand serene and beautiful. There are towns on windy cliffs whose church tower stands a beacon by day, whose lights flash signals across the encircling deep by night, towns that nestle in some corner

of sheltering hills, the red roofs peeping from "orchards bedewed with spray-drift," towns that stretch out quaint arms from old quays and harbours, towns that slumber in the clear air of the fens, whose roofs are outlined with magic beauty when the sun floods the wide flats at his setting, towns that lie within the fold of a winding river valley to mark the ford that has been used for centuries, towns that are hidden from sight till one drops upon them all unsuspecting, and towns that crest the ridges and dominate a county. They are all dear in their infinite charms, and if before the imperious pressure of modern claims they should be compelled to give way, and no hand be stretched out to save them, then the lover of English scenery, and the student of the past, would together mourn an irreparable loss.

DISCUSSION.

The CHAIRMAN, in proposing a vote of thanks to Mr. Anderson for his interesting paper, thought those present would agree that the author was a man who loved the country, and his descriptions of it showed a power which many would like to possess. But the question had to be considered from a matter of fact rather than from a poetical point of view. The decline of the country and small towns was entirely due to the desire of the people to get something they thought was better than what they already possessed, and there was no doubt that people went from the country to the larger towns purely and simply because of their many attractions. In considering the Tables given by the author, he had been struck by the fact that apparently the most popular size of town was one with between 50,000 and 100,000 inhabitants, that size of town showing respectively the largest and smallest increase and decrease in the Tables. The author had very truly said that many of the manufacturing industries in this country were finding their way into provincial towns which were suitable for such industries. He ventured to say that that inclination would go on increasing, because at the present moment many things tended in that direction. If such a development took place, the country, which the author so much loved, would be destroyed by smoky chimneys. The chief point of consideration, however, was to find employment, under the best conditions, for the large number of people there were in the country; and in that connection the decentralisation, which at present was taking place, was a very wise step. The question of inter-communication was also a serious one; railway communications must be good; and fairly cheap labour was essential. In certain industries with which he was intimately connected Rugby had been chosen as a suitable town embracing those advantages. There was one thing which was having an important effect in regard to the repopulation of the country, viz., the enormous increase in local rates and taxes. This was having a most prejudicial effect on all manufacturing industries. In particular industries of which he had intimate knowledge, the direct and indirect effect of the rates raised by the municipalities from industrial undertakings was to take away about 50 per cent. of their earnings. Moreover, they had no representation on the body which spent the money. The paper showed that there existed a great want of population in the country towns; those who governed the destinies of the people on the municipalities were doing their best to supply the want.

The vote of thanks having been carried unanimously,

Mr. ANDERSON, in replying to the Chairman's remarks with regard to the rates and the general future of municipalities, said that Mr. Wells recently read a paper before the Fabian Society in which he suggested that the present system of life led one to suppose that the municipalities of the future would have to be very much larger than they were at present; for instance, he suggested that Guildford, because it was the residence of a great many London people, was just as much a part of London as Battersea or Holborn; and that in the future, in order to adjust all the anomalies of taxation and rateability, it would be necessary for the municipalities of the country to make a much wider sweep. He thought that would be a very suitable subject of enquiry for the Commission he had suggested. With regard to the question of manufactures, he knew of instances where certain manufactures had been carried on in small country towns without in any way making them approach the worst features of city life. The whole question at present was left to private enterprise; but a national Commission might be able to make suggestions with regard to that introduction of industries, and the responsibility of carrying them on; and by benefiting certain constituent parts of the nation the country as a whole would be benefited.

ADULTERATION OF ARTIFICIAL MANURES.

In the course of their inquiry into the working of the Fertilising and Feeding Stuffs Act, 1893, the Departmental Committee appointed by Lord Onslow, whose report has just been issued, found that various frauds are practised by sellers. One method is grimly ingenious. It is to sell manures and cakes of poor quality at an exorbitant price, *i.e.*, many times above the price usually charged by the trade for stuff containing the same amounts of the various constituents. Farmers often judge of the value by

the price, and are apt to assume that a higher-priced cake is richer. In Anglesey a favourite device is the addition of sand to a 25 per cent. superphosphate so as to reduce the percentage to, say, 13 only. The mixture is sold with a guarantee of 13 per cent., so that no action can be taken, but it sells for little less than genuine superphosphates with twice the amount of phosphates. Then, again, a material is sometimes sold as a fertiliser when it really requires to undergo some treatment before it is ready to be applied to the land; feeding stuffs are sometimes adulterated with ground oat husks; invoices sometimes bear a notice that "all feeding stuffs, notwithstanding their trade name, are prepared from more than one substance or seed, unless the contrary is specifically stated." This last notice, it is thought, would not protect the vendor under the Merchandise Marks Act, although it is sufficient to do so under the Fertilisers and Feeding Stuffs Act.

The Committee have come to the conclusion that "the Act of 1893 can in no sense be described as a failure." It has acted as a beneficial deterrent against carelessness and fraud, but it has not been so entirely successful in the suppression of fraud as the framers of the Act of 1893 anticipated. And those who most required protection have benefited least. "The larger and more intelligent farmers," says the Report, "can, as a rule, take care of themselves.". Their operations are conducted on a considerable scale, and they are usually in a position to obtain their supplies from merchants in a large way of business, or even from the manufacturers direct. Moreover, being a man of greater general education, the large farmer is better able to discover whether there is anything wrong with a consignment. In the case of small men the relations between buyer and seller are a frequent bar to their taking action. Either the purchaser is, in many cases, a personal friend of the merchant, and does not like to appear to cast a doubt upon him by having his goods tested; or the farmer obtains his manures upon credit, and, being indebted to the merchant, is afraid of offending him. And there is the general unwillingness to incur the cost of analysis, or the responsibilities connected with litigation.

The Committee point out that under the Act of 1893 the seller is not required to give any statement of the constituents of a fertiliser where the sale is of less than half-a-hundredweight. It was strongly urged upon the Committee that this minimum should be abolished, and they concur in the recommendation. They say that "considerable quantities of worthless manures are sold in parcels of a few pounds, often in tins, principally to occupiers of allotments and small gardens in the neighbourhood of towns, the price charged being frequently exorbitant. Our evidence has shewn that the opportunities for, and practice of, fraud are proportionate to the smallness of the amount sold, and to the poverty of the purchaser." The Committee recommend that the section of the Act of 1893 exempting sales of less than half-a-hundredweight from its provisions should be omitted, and, among other things, that powers shall be given to Local Authorities to appoint persons, with the approval of the Board of Agriculture, to act as official samplers.

INDIAN WHEAT EXPORTS.

Attention was lately directed in the *Journal* (16th December last, 1904, p. 105) to a striking passage in the second article by the Military Correspondent of *The Times*, on "Our Warning from Manchuria," in which some figures relating to the imports of wheat into England during the past two years were quoted, and the conclusion was arrived at that, with the cessation, in case of war, of Russian exports by sea, "India stands out as our first and most important source of supply," and has become "the granary of the Empire." In a recent issue of *The Anglo-Indian Review*, Mr. Herbert Birdwood adduces statistics of Indian wheat exports since 1872-73, which strongly enforce this view. In the five years which ended with 1872-73, the annual average of exports, though swollen by an unusually large export in 1871-72 to Persia, where there was widely prevailing distress, amounted only to 326,664 cwts. (or 16,332 tons), worth £127,702. But in January, 1873, on the representation of the Bombay Chamber of Commerce, the seven per cent. *ad valorem* export duties on Indian wheat were repealed by Lord Northbrook's Government; and in the very first year after the repeal exports rose to more than 1¾ millions of cwts., the bulk of the increase being due to trade with the United Kingdom. The exports have not since, as pointed out by Mr. Birdwood, fallen below a million cwts., except in 1900-01, though "there have certainly been violent fluctuations in the trade in the last 30 years which may be ascribed generally to variations in the seasons. When the Indian crops are poor, India can spare but little; and again, when crops in the West, and the far West, are abundant, and prices are depressed, the Indian exports are only, as might be expected, moderate, but when the yields in Eupope and America, or in America alone, are moderate, then India finds an opportunity and exports huge quantities of wheat; and to enable her to do this it is not improbable that she has, at times, as has been conjectured, drawn largely from her buried stores. Any way, the net results obtained have served to place in a clear light the foresight and sagacity of Lord Northbrook's Government in adopting so readily the proposals of the Bombay Chamber of Commerce, and thus securing most material benefits for the people of India. As early as in the third year after the repeal of the duties (that is, in 1875-76) the exports rose to 2½ millions of cwts., then in 1876-77 to more than 5½ millions, and in 1877-78 to more than 6 1-3rd millions. Then

there were two comparatively lean years, as there have been also within the past decade, but in 1880-81 the figures rose to nearly 7½ millions, and in the following year to nearly 20 millions. In some subsequent years the figures went as high as 21 and 22 millions and higher, and in 1891-2 they reached nearly 31 millions of cwts. (or about 1,542,000 tons) valued at nearly 14¾ millions of £ (Rx). In the year 1903-4 the exports amounted to nearly 26 millions of cwts. (1,297,000 tons) or considerably more than double the exports of the preceding year, and about 2 3-5th times the annual average of the preceding five years. The exports for the current year will probably exceed even these figures."

"For the six quinquennial periods which have elapsed since 1872-73 the following figures show the total exports in tons for each period and the annual average for each period:—

Periods. Five years ending with—	Tons Exported.	Annual Average (Tons).
1877–78	172,000	34,400
1882–83	446,000	89,200
1887–88	936,000	187,200
1892–93	4,603,824	920,764
1897–98	1,815,830	363,160
1902–03	2,493,693	498,736

The sterling value of the exports of the last quinquennial period amounted to £19,076,694, or nearly £4,000,000 per annum, notwithstanding the comparatively poor export of 27,368 tons in 1900-01, the value of which was only £258,933. It is scarcely necessary to go on multiplying figures and facts all tending to the same conclusion—that India may now be safely regarded as the destined "Granary of the Empire"; and as increasing exports mean wider cultivation (even though, at times, resort may have been had to buried stores), and also a perceptible addition to the comfort and resources of cultivators, there can be no question as to the advantage which has accrued to India from the wise policy inaugurated by Lord Northbrook. In the Punjab alone, the area under wheat, which was less than 7 millions of acres in 1877-78, increased to more than 7¾ millions in 20 years."

The answer to the important question whether, with a larger output, the quality of Indian wheat has been maintained at the highest possible level, is, in Mr. Birdwood's judgment, disappointing. "The same quality of grain," he says, "is not, of course, to be expected in all districts where it is grown. Wheat is the principal crop on irrigated lands extending over a wide tract of country; and the conditions of soil and climate necessarily suit the crop better in some places than in others. Yet even in some districts where the best crops are not generally expected, excellent results have been obtained by special attention, especially as regards the keeping of the wheat clean for the market. A high authority, a Revenue officer of long experience, tells me that this has been the case in the Ankleswar district of the Broach Collectorate in Guzerat, where the wheat is excellent, although in the Wagra district of the same Collectorate it is only fair in quality. He classes the Bombay wheat generally (except that grown at Ankleswar) as moderate, almost poor. In the Ahmedabad Collectorate, also in Guzerat, some of the Dholka wheat is good, but it is not great in quantity. In the Dekhan and Southern Mahratta country a hard yellow grain is produced, and is preferred to any other in the older provinces of the Bombay Presidency, and is also in demand in the Mediterranean countries for macaroni, but is not liked in England; and is of inferior value to the wheat grown in Sind, and to the Punjab wheat, white and red. The soft red wheat of Guzerat, which is classed as good, is not so good as the soft white wheat of the Nerbudda Valley, which is, indeed, the best in India. Some years ago experiments were made in Guzerat in growing soft white grain; but in three years the produce was undistinguishable from the soft red wheat. An expert on wheat, Sir John McDougall, writing to Lord Cross in 1889, gave it as his opinion that Indian white wheats, 'when separated fro m all admixture,' were of very fine quality, and 'equal to the finest in the world.' It is the admixture of foreign substances, whether earth, or the seeds of other crops grown along with the wheat, according to the favourite Indian fashion, which has brought a slur on Indian wheat, which apparently will not be altogether removed so long as the form of contract in force between the Indian exporter and the English purchaser is maintained, whereby a certain 'refraction,' whether 5 per cent., or 4 per cent., or 3 per cent., is provided in respect of such admixtures, any excess above such percentage being paid for by the exporter, whereas he receives no better price if the wheat contains less than the percentage. Thus no encouragemant is given to the cultivator or the middleman to supply the exporter with cleaner wheat. On the contrary, the temptation, at all events to the middleman—for the cultivator in this matter can scarcely be held to be responsible—is to adulterate to the full extent of the refraction. It would not pay him, for instance, to sell grain to the exporter with only 2 per cent. of refraction, if the exporter himself accepts a higher rate. It has been said over and over again that if merchants insist on clean grain they will get it. If the consuming countries wish to receive cleaner wheat and will pay for it, exporters will adapt themselves to their requirements. Indeed, so far as exports from Bombay are concerned, the exporters, as represented by their Chamber of Commerce, long ago pressed for a reduction of the refraction to two per cent., with the express object of improving the character of the wheat, but their views have not as yet prevailed. The necessity for improving by mechanical means the quality of the wheat before shipment has not, however, been lost sight of in India, and the matter is indeed one demanding earnest attention. In 1889, Sir John McDougall insisted

on it as one of national importance, inasmuch as, in case of war, all sources of European wheat might be stopped, and it would be desirable that wheat should be shipped to us from our colonies in a condition fit for immediate use. He said that it would be quite impossible to grind for human food the dirty wheat then shipped from India, so long as it was uncleaned. All other Indian products were shipped in a better condition. In the same year, Lord Cross, in addressing a Conference on Indian wheat impurities, said that the percentage of dirt amounted, in some of the Indian wheats, to 7, 8, and 10 per cent., and that we were incurring the useless and foolish expense of importing a million cwts. of dirt every year from India. An expert who speaks with authority on this subject gives me as the result, at the present moment, of an adherence to the old form of contract and the refusal to accept 'mutual allowance contracts,' that freight will have to be paid in the current year 'on some 30,000 to 40,000 tons of dirt.'"

ADVANTAGES OF COAL-CUTTING MACHINES.

Among the subjects touched on by the Royal Commission on Coal Supplies, the final report of which has just been published, is that of coal-cutting machines for the working of thin seams. According to several witnesses, the chief advantages of coal-cutting machines are:—(1) That an increased percentage of large coal is obtained, and the coal got is in a firmer and better condition. (2) A more regular line of face is obtained, which facilitates ventilation, and leads to more regular and systematic timbering; and, the weight being more regular and uniform, the roof can be more easily kept up. The greater rapidity of working also tends to keep down the cost of repairs, and causes less damage to overlying seams and to the surface by reason of the subsidence being more even. (3) The regular and systematic working tends to increase the safety of the workmen. (4) Seams which either by reason of their thinness or hardness, or both, could not be worked at all, or could only be worked at a profit in times of high prices, can be worked profitably by machines. (5) Holing is less frequently done, and when it is, there is much less small than in the case of holing by hand. (6) The output is increased and is more regular, and the work is more easily superintended. Fewer explosives are used for getting down the coal, while machine work is less costly than hand work, particularly in thin seams. Under certain conditions, however, coal-cutting machines cannot be worked to advantage; these are where the roof or floor is bad, where there are numerous faults or dykes, or where the seams are highly inclined, or where the coal is very soft. One effect of the introduction of electrically-driven coal-cutting machines on a large scale has been the extensive introduction of electricity, which is invaluable from the point of view of economy and general efficiency. It is said to be well adapted for every requirement of mining and for all the general purposes of a colliery.

RURAL HOUSING.

In a late number of *The Times* Mr. Cumming Macdona, M.P., had an interesting letter, in which he pointed out that all risk from destruction by fire may be eliminated by a simple process that makes wooden structures as incombustible as stone and iron, the process that Mr. Yerkes has applied to the carriages and platforms of his newly constructed subways. Mr. A. R. Steening has since reminded those interested in the subject that in the metropolitan area, under the London Building Act, 1894, section 201, wooden houses can be erected. Prior to 1894 this could be done under the Building Act of 1855, which has the same section as the 1894 Act. It may be noted, too, that where rural authorities are content to adopt the last new by-laws for rural districts, there is no obstacle to the erection of wooden houses. By-laws 4 and 5 are the only clauses proposed affecting the walls of buildings. In other respects, as to size, material, position, strength, &c., the builder is entirely unfettered. Clause 4 makes it obligatory upon the builder of a new dwelling-house to have "a proper damp course of sheet lead, asphalte, and slates laid in cement, or of other durable material, impervious to moisture, beneath the level of the lowest floor, and at a height of six inches above the surface of the ground adjoining such wall." And clause 5 confines itself to directions as to walls of buildings when carried up above any roof, flat, or gutter, so as to form a parapet. Of course, if a district council is not content with the powers suggested by the Local Government Board in its model by-laws, it can apply for urban powers which give the right of interference so bitterly complained of.

The conditions which should influence a District Council in applying for urban powers are clearly indicated by the Local Government Board when it says "Portions of many districts are distinctly urban in character, and the development of building is constantly changing the aspect of the country, and it devolves on rural District Councils to endeavour to apply to the several parts of their districts such regulations as the circumstances may, from time to time, seem to require." Unfortunately, the District Councils are not inclined to differentiate. A series of by-laws may be made for part only of a contributory place where the circumstances justify this course, but the councils prefer powers over the whole district, with the result that the village housing problem is made much more difficult of solution than otherwise it might be. It is hoped that in the coming session time may be found to deal with this very important question.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in November and December last:—

New Charts.—2287—Tidal streams round the British isles. 2498—Scotland, west coast:—Southern part of the sound of Raasay and Inner sound. 3441—Scotland, west coast:—Gairloch. 3422—Scotland, Hebrides:—East loch, Roag. 3444—Ireland, south-west coast:—Crookhaven, Ballydivlin and Toormore bays. 3467—Iceland (plans on the north coast):—Kalshamarsnes. Blondaos, Selvig, Hagenesvig, Sandvig, Husevig, Snerstastadir, Thorshavn. 3462—British Columbia:—Southgate group and anchorage. 3464—Alaska; harbours and anchorages in. 3477—Africa, west coast:—Port Forcados. 628—Africa, west coast; Bight of Biafra:—Opobo river. 839—East Indies; Andaman islands:—Port Meadows and Kotára anchorage. 3471—Sumatra:—Banka strait. 3463—Philippine islands, Mindanao, south coast:—Dumankilas bay. 3449—China, east coast:—Amoy, outer harbour. 1260—China, north coast; Ching tsu shan to Chifu bluff, including Chifu or Yentai harbour (plan, Chifu or Yentai landing). 3468—China, north-east coast (plans on the coast of Shantung:—Malan and Lungyen coves; Yangyuchih bay; Litau bay; Ayleu bay). 3457—China, north coast:—Litau bay to Chutau, including Wei hai wei harbour. 3019—Japan, Kiusiu; north-west coast:—Imari wan and approaches (plan:—Hibi Suido). 2441—Japan, Tsugaru strait. 3455—Japan, Nipon, south coast:—Aikuchi bana to Yeboshi bana, including Nagashima wan and Kanzaki wan, Nishiki wan. 3460—Japan, Nipon, south coast:—Ino hana to Aikuchi bana, including Kada wan and Owashi wan; Kuki ura. 3458—New Guinea, plans of anchorages on north-east coast:—Buna roads; Oro bay; Port Harvey; Anasari harbour; Pusi Pusi harbour; Wamnea anchorage; Kitava island anchorage. 3436—New Zealand, east coast:—Plate island to Cape Runaway. 1103—North Pacific ocean:—Palao or Palew islands; Korror harbour; Helen reef; Mapia island; Los Martires. 3461—Pacific, Tubuai islands:—Vavitao or Ravaïvaï. 87—Spain and Portugal, west coasts (plan added:—Sines bay). 1128—Mediterranean sea, Sardinia; ports in (plan added):—Arbatax road. 2634—Mediterranean Sea, Syria; Ras En-Nakura to El Arish (plan added):—Yafa anchorage. 369—Cape Verde islands (plans added):—San Filippe and Encarnaçao anchorages; Port St. Jago (new plans):—Porto Praya; English road (Mayo I.). 3004—Iceland, places on the south and east coasts (plan added):—Vastmannaeyjar. 652—Africa, east coast (plan added):—Mozambique anchorage. 1809—Africa, east coast: Mozambique to Ras Pekawi (plans added):—Port Duarte Pedroso; Belmore harbour; Port Nakala. 764—South-west Pacific, New Hanover, &c. (plan added):—Peter haven. 55—South-west Pacific, New Ireland, &c. (new plan):—Nusa harbour.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—1167—England, west coast:—Bury inlet. 1543—England, east coast:—Yarmouth and Lowestoft roads, &c. 1625—England, east coast:—Seaham harbour. 2296—Baltic:—Gulf of Bothnia, sheet 1. 2646—France, west coast:—Bourgneuf to Ile de Croix. 2989—France, west coast:—Entrance to the Loire river. 2664—France, west coast:—Point d'Arcachon to Pointe de la Coubre. 92—Spain, west coast:—Cape St. Vincent to Gibraltar. 1567—Africa, north coast:—Approaches to Bona. 308—North America:—Gulf and river of St. Lawrence. Plans in. 2818—United States, east coast:—Hampton roads. 969—South America:—Pernambuco roads. 551—South America, east coast:—Port San Antonio. Port St. Elena. 461—Africa, west coast:—Wari and Benin rivers and creeks. 622—Africa, west coast:—Bonny and New Calabar rivers. 1810—Africa, east coast:—River Zambesi to Mozambique harbour. 665—Africa, east coast:—Zanzibar harbour and its approaches. 1235—Persian gulf:—Mouth of the Euphrates. 1419—Bay of Bengal. Andaman islands:—Long island to port Blair. 1348—Borneo:—Natuna islands. 1180—China, east coast:—Approaches to Hongkong. 2618—China sea. Formosa, north coast: Ke lung harbour. 1798—China, north coast:—Kwang tung peninsula, &c. 1259—Korea:—Fusan harbour. 2875—Japan. Naikai (Seto uchi). 2924—Australia, east coast:—Cape Grafton to Hope islands. 2923—Australia, east coast:—Hope islands to Turtle group. 939—New Guinea:—Cape Nelson to Hercules bay.

These charts are issued by Mr. J. D. Potter, 145, Minories.

OBITUARY.

Sir George Cotton, J.P.—Sir George Cotton, one of the leaders in the building up of the cotton-spinning industry in India, died suddenly on the 5th inst., at the Langham Hotel. He was born in Ireland in 1842. In 1863 he went to Bombay as manager of the East India Cotton Agency, and at once became prominent in the business and public life of that city. In 1870 he started, with Mr. James Greaves, the firm of Greaves, Cotton, and Co., Bombay, and J. Greaves and Co., Manchester. A correspondent of *The Times* says—in course of time the firm started or secured the agency for ten or twelve mills, and now it has under its control some 300,000 Indian spindles. Sir George Cotton took a most active part in the formulation of local com-commercial opinion, and in the civic and philanthropic life of Bombay, serving for years on the local corporation, of which he was twice elected president. He was a Fellow of the University of Bombay, and held the office of Sheriff. The unique influence

Sir George Cotton exercised over the working classes in Bombay was a most valuable factor on the side of law and order in times of public unrest. In the great famines of 1897 and 1900 Sir George took a leading part in administering the charitable relief funds locally collected and those assigned to Western India from the large amounts subscribed to the central organisation in Calcutta from Great Britain and various parts of the Empire. Sir George Cotton's standing in Western India was stated in a farewell address presented to him at the town-hall by his fellow citizens when he finally transferred his home to Manchester four or five years ago. "You will carry home with you to England," said the address, "the affectionate regard of many races and creeds, who will long remember you as a just, broad-minded, and public-spirited citizen." He was elected a member of the Society of Arts in 1891, and received the honour of knighthood in 1897.

A. C. Cronin.—Mr. Alfred Charles Cronin, solicitor, died on the 6th inst., at Assouan, Egypt, aged 64 years. Mr. Cronin was elected a member of the Society of Arts in 1899. In the same year he served as Master of the Clothworkers' Company, of which company he was an active and influential member.

GENERAL NOTES.

Nobel Peace Prize.—The Board of Education have received through the Foreign Office an intimation that, in order to be eligible for the Nobel Peace Prize, which will be awarded in December, 1905, candidates must be proposed to the Nobel Committee of the Norwegian Parliament before February 1st next. The following persons alone are qualified to recommend candidates:—1. Members of the Nobel Committee of the Norwegian Parliament. 2. Members of the Legislatures and Governments of different countries. 3. Members of the Conseil Interparlementaire. 4. Members of the Commision du Bureau International permanent de la Paix. 5. Members and Associates of the Institut de Droit International. 6. Professors of Law and Political Science, of History and of Philosophy in the Universities. 7. Persons who have received the Nobel Peace Prize. The Nobel Peace Prize can be granted to an institution or an association, not only to an individual. Inquiries for further information should be addressed to the Comité Nobel du Parlement Norvégien, Victoria Terrasse 4, Kristiania, Norway.

Beet Sugar.—A late circular of the West India Committee contains some figures throwing light on the enhanced price of sugar caused by the shortage of the beet crop:—On October 1, 1903, the visible supply of sugar of all kinds was 1,879,031 tons, and the beet crop of the season 1903-4 yielded 5,864,938 tons, the cane crop 4,423,800 tons, and the American beet crop 210,000 tons—making a total supply for the season of 12,377,769 tons. The total supply for the season 1904-5 is estimated at no more than 10,917,532 tons, arrived at as follows:—Visible supply on October 1 last, 1,434,532 tons; estimated beet crop of 1904-5, 4,685,000 tons; cane crop, 4,607,000 tons; American beet crop, 191,000 tons. Deducting the visible supply on October 1 last from the total supply of the 1903-4 season, it will be seen that the consumption of that season was 10,943 257 tons—25 725 tons more than the estimated total supply of 1904-5. Thus the total amount available will be short of the consumption, even assuming the consumptive demand to be no greater than in 1903-4, whereas the cheapening of sugar in Europe through the abolition of the bounties and kartels has largely increased the demand there. There is a slight increase in the cane crop, and a considerable development of cane sugar cultivation in the various tropical and sub tropical countries which are adapted to its growth, is expected.

The Sub-division of Australia.—The New South Wales Department of Lands has just published an interesting statement illustrated by diagrams. It shows the sub-division of Australia into separate colonies between 1787 and 1863. The facts are opportune at a time when the question of Federal capital territory is being discussed. In 1787 the Royal Commission to Governor Phillip declared the territory of New South Wales and its dependencies to be about half of all Australia. In 1825 Van Diemen's Land (Tasmania) was separated from the mother colony, who in 1836 had a big slice taken from her and named South Australia. In 1850 a portion was taken to form Victoria, and in 1859 the mother colony gave half of her then possession to form Queensland. In 1863 more than half of the half left was given to South Australia, and New South Wales shrunk to about a fifth of what she was in 1787.

The American Forestry Congress.—This Congress, recently held in Washington, was the largest of its kind since 1883. The interests represented included railway, mining, lumbering, agricultural, stock raising, and irrigation. Of the interesting facts brought out one was that the Pennsylvania railroad, owing to the scarcity of timber in the country it covers, is planting trees along its tracks, and along several abandoned tracks, to be used in the future for the making of ties. Another was that the mining industry of the United States uses more timber than the railroads.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

February 22.—"Some Misconceptions of Musical Pitch." By John E. Borland. (*a*) *Visual*—due to conventional but inaccurate notation;

(*b*) *Aural*—volume of tone mistaken for depth, brightness for height. Illustrated by voices, instruments and diagrams. SIR WILLIAM PARRATT, M.V.O., will preside.

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN, F.S.A. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London. The RIGHT HON. VISCOUNT RIDLEY will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

FEBRUARY 21, 8 p.m.—"The Queen Victoria Memorial as compared with other Royal Memorials Abroad." By MARION H. SPIELMANN, F.S.A. JOHN BELCHER, A.R.A., President of the Royal Institute of British Architects, will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Four Lectures.

LECTURE II.—FEBRUARY 20.—*Indicator Diagrams and Power Tests*—Diagrams from engines using coal gas, producer gas, blast furnace gas, petrol and heavy oils—Practical efficiencies and limitations in large and small motors for constant volume and constant pressure engines—Brake tests—Irregularities in diagrams, pre-ignitions, back ignitions, exhaust explosions, missed ignitions.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Dugald Clerk, "Internal Combustion Engines." (Lecture II.)—Indicator Diagrams and Power Tests.

Society for the Encouragement of Fine Arts, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. Charles E. Keyser, "The Churches of Sparsholt and Childrey in the County of Berks, an Architectural description with Lantern Illustrations."

Imperial South African Association, Caxton-hall, Victoria-street, S.W., 8½ p.m. Sir Gilbert Parker, "South Africa and its Problems of To-day."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. R. Blomfield, "Architectural Education."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Colonel G. Mackinlay, "Biblical Astronomy."

TUESDAY, FEB. 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Marion H. Spielmann, "The Queen Victoria Memorial as compared with other Royal Memorials Abroad."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Structure and Life of Animals." (Lecture VI.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on papers by Mr. E. F. C. Trench, "Alfreton Second Tunnel," and by Mr. Dugald McLellan, "The Reconstruction of Moncreiffe Tunnel."

Statistical, in the Theatre of the United Service Institution, Whitehall, S.W., 5 p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. John E. Borland, "Some Misconceptions of Musical Pitch."

Geological, Burlington-house, W., 8 p.m. 1. Rev. John Frederick Blake, "The Order of Succession of the Manx States in their Northern Half, and its Bearing on the Origin of the Schistose Breccia." 2. Mr. Francis Edward Middleton, "The Wash-outs in the Middle Coal Measures of South Yorkshire."

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Col. Lord Raglan, "The Militia in 1905."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, FEB. 23...Tramways and Light Railways Association (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. Herbert Jones, "The Waterloo and City Railway."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. J. J. H. Teal, "Recent Work of the Geological Survey." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. G. L. Addenbrooke's paper, "The Value of Overhead Mains for Electric Distribution in the United Kingdom."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, FEB. 24...Cyclist Touring Club, John-street, Adelphi, W.C., 8 p.m.

Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Dr. Marshall Ward, "Fungi."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. F. D. Flint, "Morecambe Sewerage: Method of Laying a 15-inch Cast-iron Sewer under the London and North-Western Railway." 2. Mr. H. M. Rootham, "The Reconstruction of Bow-bridge over the River Lea."

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Mr. F. J. Osborne Smith, "Country Houses and Accessory Buildings."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m. 1. Dr. C. V. Drysdale, "The Curvature Method of teaching Geometrical Optics." 2. Mr. R. J. Sowter, "Exhibition of Dr. Meisling's Colour Patch Apparatus." 3. Mr. J. Schofield, "A Method of Illustrating the Laws of the Simple Pendulum, and an Exhibition of Strong Models of Optical Systems."

SATURDAY, FEB. 25...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. G. Hogarth, "Archæology." (Lecture I.)

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FRIDAY, FEBRUARY 24, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 27, 8 p.m. (Cantor Lecture.) DUGALD CLERK, "Internal Combustion Engines." Lecture III.

TUESDAY, FEBRUARY 28, 4.30 p.m. (Colonial Section.) C. F. JUST, "The Manufactures of Greater Britain.—I. Canada."

WEDNESDAY, MARCH 1, 8 p.m. ISIDORE SPIELMANN, "The British Art Section of the St. Louis Exhibition."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 20th inst., the second lecture of his course on "Internal Combustion Engines," was delivered by Mr. DUGALD CLERK, M.Inst.C.E.

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, February 21st; JOHN BELCHER, A.R.A., Pres.R.I.B.A., in the chair.

The paper read was "The Queen Victoria Memorial as Compared with other Royal Memorials Abroad," by Marion H. Spielmann, F.S.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

ELEVENTH ORDINARY MEETING.

Wednesday, February 22, 1905; JAMES E. MATTHEW in the chair.

The following candidates were proposed for election as members of the Society:—

Bacon, John Henry Frederick, A.R.A., 33, St. John's Wood-road, N.W.
Dickson-Brown, S., M.A., 31, Regent-square, W.C.
Earnshaw, Henry, 14, St. Mary-axe, E.C.
Evans, William Bailey, 20, West-parade, Huddersfield.
Fergie, George, Copiapó, Chili, South America.
Lello, Montague Nodes, 100, Belsize-road, South Hampstead, N.W.
Little, Robert, Singapore, Straits Settlements.
Minett, Richard, F.S.A.A., Municipal Offices, Cheltenham, and Cedar-lodge, Cheltenham.
Rolfe, William, 3, Adelaide-street, Charing-cross, W.C.
Steuart, James, 205, Clay-street, Baltimore, Maryland, U.S.A.
Tosh, William, J.P., M.I.Mech.E., P.O. Box 1132, Johannesburg, Transvaal, South Africa.
Williams, D. Neziah, 29, Tudor-terrace, Merthyr Tydfil, Glamorganshire.

The following candidates were ballotted for and duly elected members of the Society.—

Allen, Caleb J., Hillside-house, Lancaster.
Allis, Edward Phelps, jun., Palais Carnoles, Mentone, France.
Bingham, Charles Henry, 13, Great Brunswick-street, Dublin.
Cloud, John W., 82, York-road, King's cross, N.
Colabawalla, Dinshaw D., opposite Chira Bazar, Bombay, India.
Johnson, Edward, 605, Salisbury-house, E.C.
Kelly, Alexander, 100, Hyde-park-street, Glasgow.
Llanos, E duarde, 56, Leadenhall-street, E.C.

Parish, William Francis, jun., The Vacuum Oil Company, Ltd., 4, Norfolk-street, Strand, W.C.
Polden, Francis C., A.M.I.E.E., The Rhodesia Railways, Limited, P.O. Box 420, Bulawayo, Rhodesia, South Africa.
Schumacher, Harry A. P., 333, Calle Echaurren, Santiago, Chile, South America.
Sprague, Thomas Bond, LL.D., 29, Buckingham-terrace, Edinburgh.
Stuart-Fox, Julius J. S., The Western Telegraph Company, Ltd., Rio de Janeiro, South America.
Welbury, William, Middleton-crescent, Leeds.

The paper read was—

SOME MISCONCEPTIONS OF MUSICAL PITCH.

By John E. Borland, Mus.B.

Definition of Subject.

It is desirable to preface the following paper with a definition of its scope. Negatively stated, it has no concern with *standards* of pitch, such as the Diapason Normal, the new or the older English Philharmonic pitch, the Society of Arts pitch, the Scientific pitch (C 512) or the many unauthorised varieties, ranging from two or three semitones below any of these standards — to be found in suburban and country places where the rounds of the pianoforte tuner are as rare as angels' visits—to the extreme military pitch which is a semitone higher than the present orchestral pitch. We shall assume that there is but one existing standard, and this is equivalent to saying that, for the sake of argument, we shall endeavour mentally to realise a musical millennium.

Stated affirmatively, this paper will draw attention to two aspects of the pitch question which are of vital importance to music-lovers who desire to form a clear conception of the real height or depth of musical sounds, whether presented to the eye in musical notation or to the ear in actual tone. We must try to keep distinct these two aspects of the subject, though a little overlapping is inevitable because at least some of the mistakes of the ear are due in the first instance to the deception of the eye.

Limits of time, it should be added, make necessary the use of a somewhat dogmatic method of stating conclusions which have in all cases been arrived at after full consideration of proved facts.

(A) VISUAL MISCONCEPTIONS.

The stave-notation which has been in use, with modifications, for about five centuries, is commonly spoken of with pride as a pictorial representation of musical sounds. In a sense, this is true; but the picture which the unaided notation now offers to us is far from complete, and the power to read intelligently a full orchestral score, much more to write one, postulates the possession of a perfect memory, a wide knowledge of musical history, and an intimate acquaintance with the uses of many instruments. A simple vocal score is not without its pitfalls, and even the two pianoforte-staves present anomalies in extreme keys, and in chromatic music, with which we could well dispense.

Musicians have a great affection for the notation which has served for the recording of the masterpieces of the past, and it is extremely difficult to put one's self, as it were, outside one's life-work, and to criticise calmly and dispassionately so venerable an institution as the stave-notation. But when once this step has been taken, it is impossible to remain blind to the fact that, however well the fundamental principle of the notation may have suited the simple, diatonic vocal music of Palestrina, it had already become somewhat of a hindrance to the art by the time of Bach, still more so for Beethoven, and a perfect mass of incongruity and ambiguity in the hands of Richard Strauss.

The Clef System.

This was designed to present varying groups of lines and spaces fit for simple vocal music, which was short in compass and sedate in movement. By altering the positions of clefs, C or any other note was made to appear in any position; and so long as music remained simple this offered little inconvenience to the eye. But with the growing complexity of musical design the full use of the clef system became impossible, and at the present time only two forms of clef are in common use for voices, viz., the G clef on the second line, and the F clef on the fourth. The diagram A (p. 351) shews some of the various ways in which "Middle C" has been written for voices.

Modern composers have already admitted tacitly the inconvenience of this variable system, and the result is the virtual disappearance of the C clef from vocal scores. The Alto part can be fairly well accommodated on the lower ranges of the Treble stave, but the

Tenor part offers a serious difficulty. It is too high, usually, for the Bass stave, too low for the Treble, while the use of its own C clef has been abandoned by common consent of singers, composers, and publishers*. The result is that the Treble clef is now used for Tenor parts, with the notes written an octave higher than they sound. Sometimes the printer records this fact at the beginning of a piece, but if an intermediate page is opened there is nothing to show which is the Tenor stave, or which of the Treble clefs is to be read literally, and which an octave lower. Mr. McGranahan, the compiler of a book of Revivalist hymns for male voices, uses a C clef in the third space for his Tenors, thus making the stave correspond, as to the names of notes, with the Treble stave. This seems a sensible arrangement; anyone who knows the Treble clef can read from it, while the correct octave is indicated by the form of the clef. But purists would have none of it. Though C had been placed on every line of the stave, the clef had never been seen in a space before, therefore it must not be. So we use a Treble clef instead, which indicates sounds an octave higher, and think we are valiant defenders of historic accuracy. Mr. Otto Goldschmidt, in the "Bach Choir Magazine," introduced a double Treble clef for Tenor voices, but his example has not been much followed.

* This change dates from the time when choral singing passed into the hands of *amateur* vocalists. The Tonic Solfa Notation was another outcome of the Victorian era—another amateur protest against complexity.

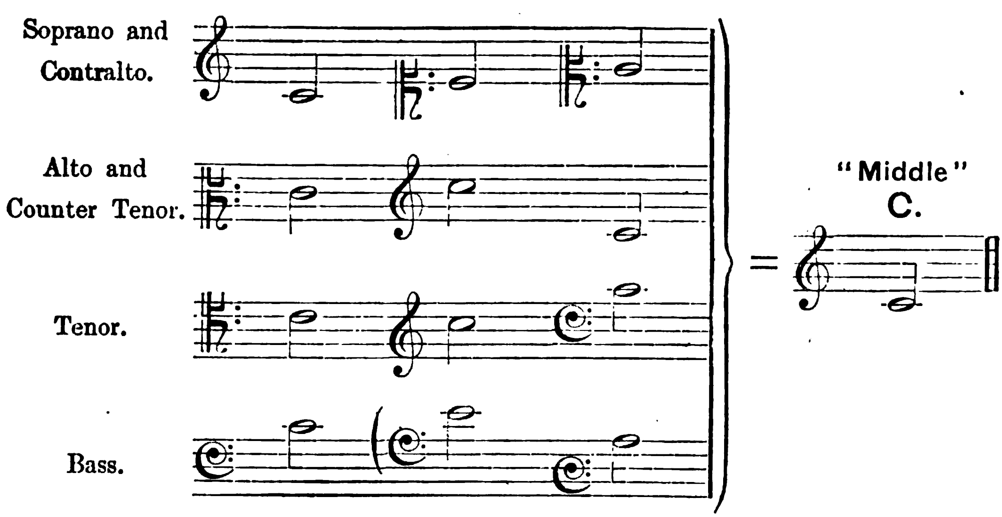
The Alto voices, as already mentioned, can be accommodated on the Treble stave at their accurate pitch, but this has not invariably been done. Old oratorio scores, published during the transition stage when the C clefs for voices were passing out of use, give the Alto part on a Treble stave an octave higher than the real sounds, and a good deal of male-voice part-music followed the same undesirable custom.

Assuming that it is the desire of musicians to make their art of the greatest possible service to the race, it is easy to see many ways in which its notation could be greatly simplified, and a reform of the clef system is one of them. Of course, to such as love mystery and confusion for their own sakes, it is useless to appeal; and it is equally futile to address those to whom Professionalism stands before Art. The latter class is interested in making the doors of Art hard to open, like members of another profession who are said to make a farthing's worth of cinnamon and water become chargeable at half-a-crown by writing the prescription in abbreviated dog-Latin and illegible calligraphy.

Looking at the matter with an open mind, is there any reason beyond tradition why all staves should not have C in the same position?

The middle line would be a good place for C (as the present Alto clef). This arrangement would give us an extra note upward for Trebles, and an extra note downward for Basses, and the middle stave would serve

DIAGRAM A.—VOICES.



equally well for Tenor and Alto voices. The clefs would then show merely the octave in use, and it would be better still to discard the fancy signs altogether and use numerals so that the series could be extended upwards indefinitely.

TRANSPOSING INSTRUMENTS.

The inconsistency and irregularity of our Notation, as used for instruments, put entirely into the shade the troubles of the vocal score. "Transposing-instruments," it may be desirable to explain for the benefit of those to whom an orchestral score is unfamiliar, are instruments which give sounds quite different from those noted down. The simplest form of transposition is that of an octave, and has arisen mainly because of the limited compass of the three clefs (which were originally designed for vocal music), as compared with the wider range of the orchestra, from the low E or D of the double-bass in the 16 ft. octave, to the top notes of the piccolo, which reach the upper extreme of the pianoforte keyboard. The double-bass occupies most of its time in producing sounds which are below the ordinary bass-stave, while the piccolo would find only three or four of its notes on the treble stave if the actual sounds were written. Hence the custom has arisen of writing the bass part an octave higher, and the piccolo part an octave lower, to the confusion of many a budding composer, who, though he knows these facts in the back of his mind, is not always practically conscious of them, as his scores indicate.

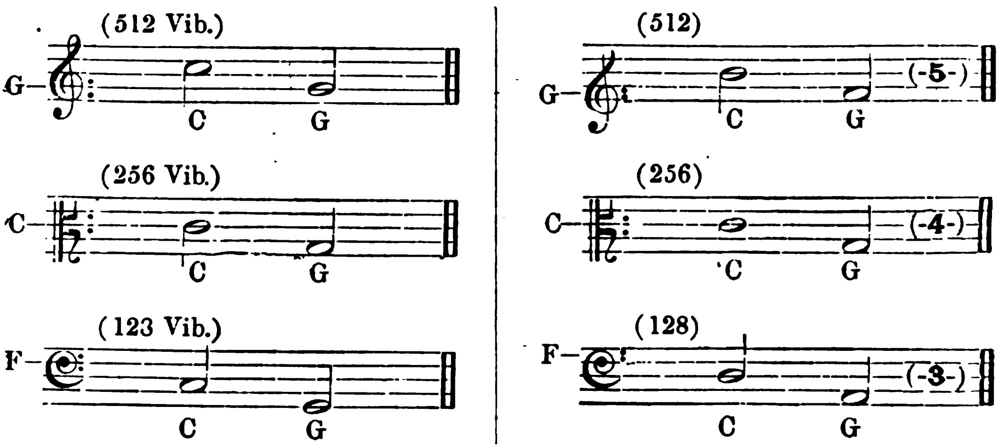
But this octave-transposition, due to the lack of expansiveness of our clef system, is as nothing compared with the chaos of other transposing-intervals which the orchestral developments of the last two centuries have brought about. Under this system a given note on paper may sound at any pitch within about two octaves and a half. Could anything be more subversive of a clear conception of musical pitch on the part of composers, players or listeners? The three following diagrams show something of the state of affairs. (See Diagrams C, D, and E.)

How has this confusion come about? The octave intervals included in these diagrams are mainly due, as before shown, to the limitations of the clefs. The other intervals (seconds, thirds, and so on, in addition to the octave in some cases) are due to former imperfections of mechanism on the instruments themselves. From the seventeenth century until early in the nineteenth, the wind instruments could only produce with difficulty anything beyond a diatonic scale in two or three keys, and the trumpets and horns could not do even that. If any proof be needed to show that this kind of transposing is wholly due to former incompleteness of mechanism and has no more rational basis, it may be found in the history of the slide-trombone, which, possessing a complete chromatic scale from an early epoch, has always had its real sounds indicated.

So long as the transposing instruments in the orchestra were few in number and their music was simple, the inconvenience was but slightly felt. But although instrument

DIAGRAM B.

PRESENT USE OF THREE CLEFS. A POSSIBLE SIMPLIFICATION.



makers have now removed the original reason for transposing, and composers are now writing parts of increasing complexity and number, the old system is maintained, without rhyme or reason except custom, the fear of criticism, and possibly the sort of laziness that will sometimes blunder on with an untidy workshop, or writing desk or music cupboard, rather than tackle the problem of putting things straight. We again hesitate to suggest a fourth cause, *i.e.*, deliberate intention to keep the art of music in the hands of a close corporation. Antiquarianism is all very well when kept to its proper sphere, viz., the *study* of past things, but it is a nuisance when it endeavours to compel us to do twentieth century work with the tools of the seventeenth century.

[Quotations from the scores of Haydn, Berlioz, Brahms, Mackenzie, and Richard Strauss, were at this point brought forward to illustrate the growth of the present confusion.]

Is there *anything* to be said in favour of the maintenance of the transposing system? We reply without hesitation in the negative—with a possible mental reserve in the case of the clarinet family. Owing to some mechanical difficulties which have not yet been fully overcome, it may be desirable for a few years to maintain the use of clarinets (of each compass) in two keys (not more); but this must be looked upon as a temporary expedient, a concession to their imperfection, which time and the makers' skill may be trusted soon to remove. Speaking broadly, the whole transposing system could be swept away to-morrow if composers and publishers would but undertake the task, and the gain to the art would be enormous. There is commonly said to be a serious technical difficulty for players who have to use several instruments of different pitch, if the actual sounds are shewn in their copies; but this is much exaggerated. Flute players (on the modern concert flute) play quite well the rare passages written by Spohr and others for the flute in F, or E flat. Clarinet-players voluntarily discard the C clarinet, and sometimes the A clarinet, and play everything on their favourite B flat instrument rather than change it. Trombonists read and play actual pitch without difficulty on instruments pitched in E flat, B flat, and G respectively. Horn and trumpet players, having now complete chromatic scales at their disposal, read any part and reproduce it on any of their numerous crooks which they may prefer. The Euphonium and the Bass Tuba (of the "Sax" tribe) use actual pitch, and

DIAGRAM C.—INSTRUMENTS OF HIGH PITCH.

players find no difficulty in changing to other members of the same family of instruments; while a last illustration may bring the point home to a larger number of hearers, viz., violinists do not look for a part transposed a fifth higher, and try to imagine they are still playing a violin, when they take up a viola.

With one word more, we pass from this part of the subject. The confusion in the orchestra is bad enough, but in a brass band it becomes positively laughable. In some bands not a single instrument gives the sounds indicated in the parts. The Treble clef alone is used, even for the bass instruments, and everybody transposes besides. Could anything be more stupid? The result is that many a bandsman never acquires any sense of absolute pitch. He has a hazy ideal in his mind, known as "concert" pitch; but it is an abstraction, outside of his daily experience.

Equal Temperament.

Musicians speak with warmth of the achievement of J. S. Bach in the establishment for ever of equal temperament, or the division of the octave into twelve equal semitones, as the basis of music. But Bach has been dead 155 years, and we still stumble on with a notation which is incapable of showing the real facts of music in this respect. Bach, Beethoven, Schubert, Spohr, Weber, Schumann, Mendelssohn, Brahms, Grieg, Wagner, Strauss, and a host of others* have declared in unmistakable terms that C sharp and D flat are the same sound, A sharp and B flat, F sharp and G flat, and so forth, but they have no means of showing it to the eye, and theorists have filled many books with explanations of the supposed differences between these pairs of notes. The subject is too vast for the present occasion, and I can only refer briefly to it and to an admirable attempt which has been made to remove the difficulty, viz., by Mr. W. H. Thelwall in his semitonic notation. There are many musicians who refuse even to consider any radical reform of the existing notation, and to such it is useless to speak. They look upon it almost as an inspired thing, or at least as an historic growth, to be preserved with veneration and awe. This attitude would invite more respect if it did not form such a bar to progress, and if it were more in conformity with the procedure of artists and scientists in other walks of life. The vital question is, are we to maintain at all costs a form of notation which no longer represents the facts of music, because it once did so? Should a gardener leave dead or non-productive branches on an apple-tree because they once bore fruit?

There can be no doubt that primarily our notation was intended for purely diatonic music. For this it was well fitted; but it is only poorly adapted to record modern developments since Bach's time. F sharp and G flat are not essentially connected with either F or G; they are separate sounds, or in equal temperament one separate sound, owning no allegiance to either F or G. The lack of prophetic foresight on the part of seventeenth century musicians with regard to possible developments is indicated by an extract from Playford's "Introduction to the Skill of Music" (1654). After describing the ordinary keys, with few sharps or flats, he says: "There may be more thought on to puzzle young beginners, but not of any use, here being variety enough to please the ear." Later, speaking of clefs as well as keys, he says: "I would advise you at the first to get

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* Some Authorities, on Equal Temperament.

"It is certain, evident, indisputable, that the 21 signs of the enharmonic scale contain really nothing more nor less than the 12 degrees of the chromatic scale . . . . D flat is neither flatter nor sharper than C sharp; these notes have the same meaning, they express the same sound. Sameness of meaning for different signs—that is, enharmonic equivalence—is the source of all the wealth in modern art. Suppress the tempered system, suppress enharmonic equivalence, the sameness of meaning for different signs, and by the same act you suppress the most beautiful inspirations of composers, you suppress music itself."—(Report of Conference of French experts, including Auber, Halévy, Berlioz, Gounod, and Ambroise Thomas; quoted by Helmholtz.)

"In all cases the scale is an artificial product contrived for particular artistic ends. The old scale, with a limited number of available notes, was sufficient for the purposes of the old church music, because the aims of the art were different. The growth of modern music brought new aims into men's minds, and they had to contrive a new scale system to satisfy them. The division of the octave into twelve equal intervals, to which Bach gave his full sanction, is now a commonplace of every musical person's experience."—(Sir Hubert Parry, "The Art of Music," p. 188.)

"An ideally-tuned scale is as much of a dream as the philosopher's stone, and no one who clearly understands the meaning of art wants it."—(Ibid., p. 46.)

"This duodecimal division of the octave (equal temperament) was known to the Greeks, but its modern revival, which dates from about the sixteenth century, has been one of the happiest and most ingenious simplifications ever known in the history of music, and has had the effect of advancing the art to an incalculable extent."—Dr. W. Pole, Grove's "Dict. of Music and Musicians," article, "Scale.")

"The greatest amount of patience and perseverance must be expended on section IV. (part II.), in which the foundation should be laid of pure intonation . . . . Let it be remarked that by pure intonation is meant that which is according to equal temperament; for modern music no other exists."—(Spohr, Preface to the "Violin School," Eng. trans.)

any song you meet with put into one of the Natural Keys; also I would have you make use of the Treble Cliff, being always placed on the second line from the bottom of your five; the Bass Cliff is not so common as that, although it's as certain as the other; but the Tenor Cliff is very uncertain, for you may find it placed upon every line of the five, except the uppermost."

representing music itself, in its broadest and most scientific aspects. Modern music, which becomes impossible without equal temperament, is here represented exactly as its composers conceive it. Not only are the supposed differences between F sharp and G flat and similar pairs of notes ignored, as all composers since Bach have ignored them, but all the confusion of clefs is abolished, so that a given

DIAGRAM D.—INSTRUMENTS OF MEDIUM PITCH.

In presenting before you two diagrams of Mr. Thelwall's "Note for Note Notation" (pp. 357-8), I would draw careful attention to one point; it is not especially adapted for any one instrument, like some other attempts have been (based, in fact, upon the pianoforte keyboard, a thing which is itself of a fortuitous and unscientific origin), nor for voices, like the Tonic Solfa; but this notation aims at note in each octave appears in the same stave-position, while the octaves are indicated by figures.

In Diagram F we see the scale of G in its semitonic major and two minor forms. No sharps or flats are required as a "signature," because actual pitch is indicated by the notation without any such qualifying signs. Whole tones proceed from space to space or

line to line, semitones from line to space or space to line.

Diagram G shows the emancipation of the so-called extreme keys under this system. There is no valid reason why the keys of F sharp or C sharp should be penalised as they are by the established notation. It ought to be as easy to read and to play in these keys as in the so-called natural key of C, but owing detract from the merit of his invention. Its universal employment would save a large amount of the time which it is now necessary to devote to the overcoming of the mere notational difficulties with beginners. Amateur musical opinion is quite capable of carrying this new thing to a successful issue even in the face of professional opposition, if its advantages are once appreciated.

DIAGRAM E.—INSTRUMENTS OF LOW PITCH.

to imperfections of notation and of instruments this is far from being the case. Mr. Thelwall has removed the difficulty from the notation, and is to be congratulated upon the scientific attitude he has adopted towards musical theory and upon his method of applying his deductions in his notation. There are enormous obstacles in the way of its adoption, chief of which stands vested interest, but this does not

(B) AURAL MISCONCEPTIONS.

In this second part of our subject, which deals with misconceptions of pitch, due to natural defects or imperfect training of our ears, it is impossible to speak quite so strongly as in the former part, because here the personal equation has to be reckoned with. We do not all hear the same sounds in the

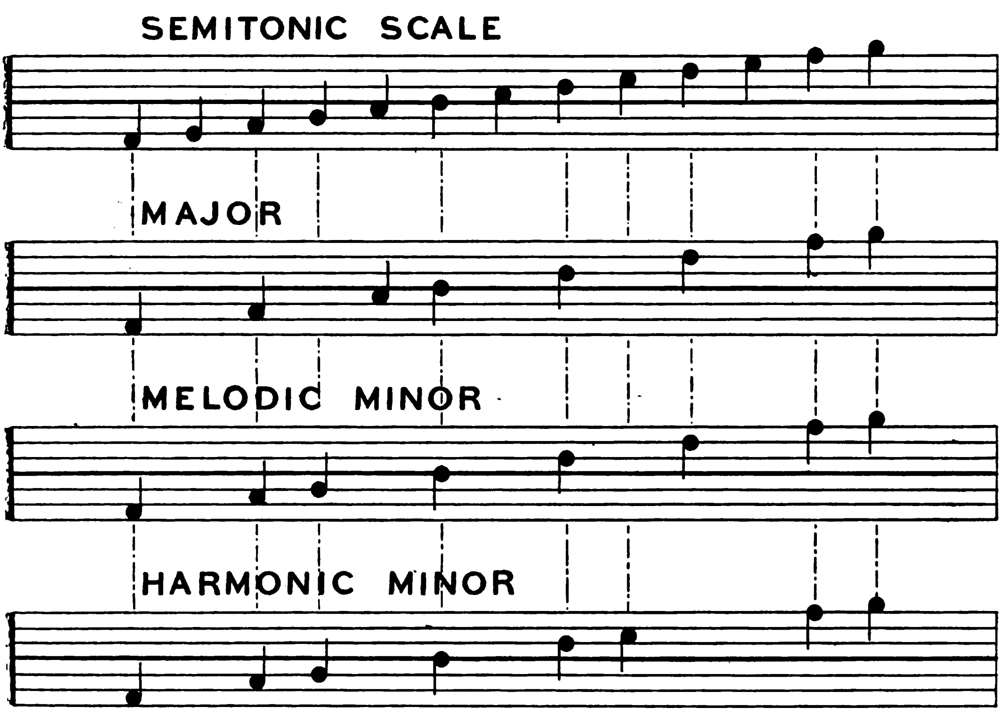
same way. Some ears are keen, others dull; others again are long, in the proverbial sense, so that their possessors never appreciate what they may actually be hearing.

Misconceptions are also due to external circumstances. Our power of estimating the actual height or depth of a sound is frequently discounted by the proximity of other sounds which are higher or deeper. For example, the low C of a violoncello seems quite a fine deep bass note in a string quartet; in company with the double bass or with organ pedals it seems a very ordinary tone, not particularly full, and not very deep. The resonance, or otherwise, of buildings has also much effect upon our hearing of sounds.

Scientifically stated, height or depth of pitch depends upon the number of vibrations in a given time. Thus, middle C is said to have 256 vibrations in a second, treble C 512, and so forth. But in practice we seldom hear a pure and simple musical tone, even the simplest of the ordinary sounds being combinations of many overtones with the prime sound. The extreme harshness of some dissonances in modern choral music is largely due to this cause. The result is that the ear often judges a bright tone to be higher in pitch than it really is, owing to the presence in considerable strength of its upper octave and other harmonics. By the kindness of Messrs. J. W. Walker and Sons, whose organs are famous for their varied and delicate tone-quality, I am enabled to demonstrate this with some organ pipes. These, and other experiments, I present with the full consciousness that they may not be convincing to all listeners equally, owing to differences of ear. We have before us a pipe sounding Tenor C, of a dull fluty tone. This gives us an impression of depth which is quite absent from another pipe, of the Gamba class, of which the fundamental sound is the same. This reedy tone suggests to the ear that at least some other sounds are present with the fundamental, and this is indeed the case. In extreme instances it is possible to make a tone

DIAGRAM F.

THELWALL'S NOTE FOR NOTE NOTATION



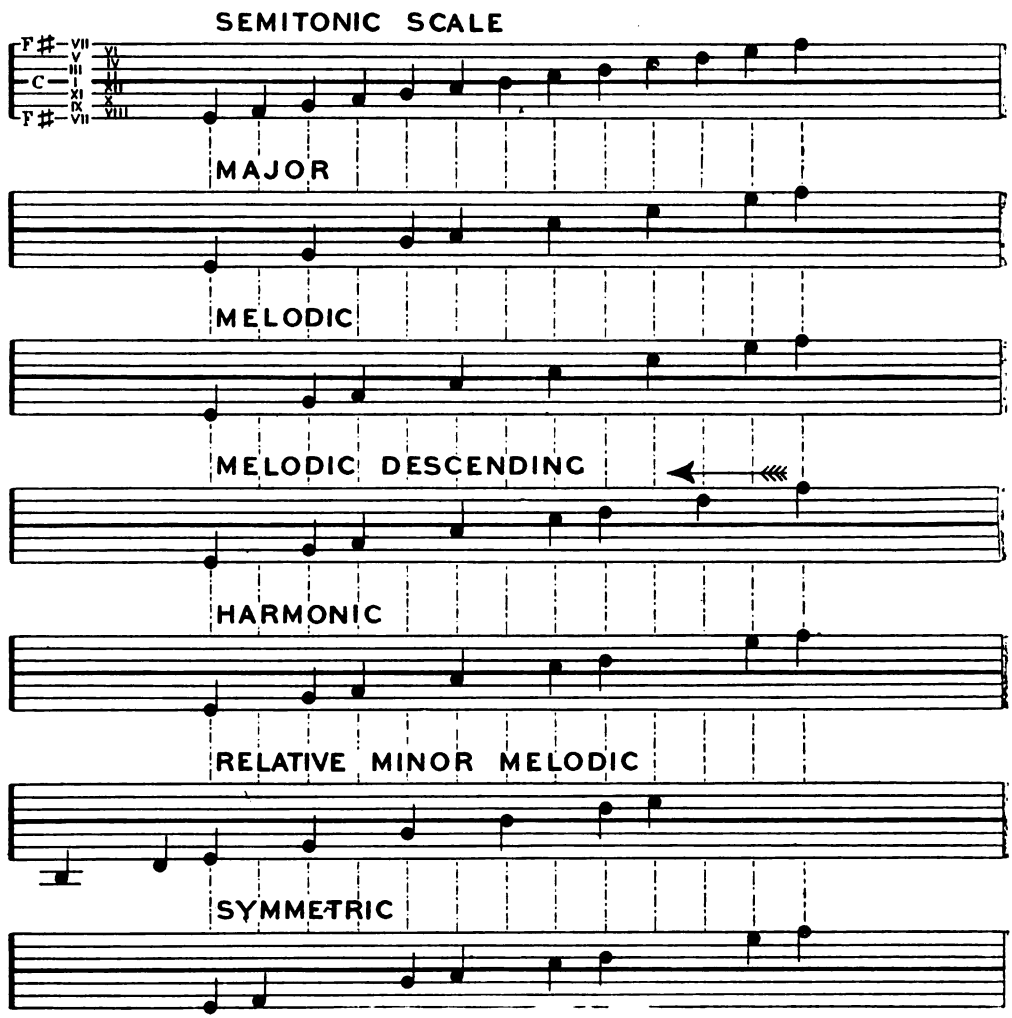
so reedy that the fundamental sound seems to have disappeared altogether or can only be heard with effort. An interesting experiment can be made by adding smaller and higher tones in proper proportions to a fluty fundamental sound, and obtaining by the combination an effect which is identical with that produced by the single pipe of bright reedy tone.

In addition to the difficulty of judging pitch which is caused by the presence or absence of harmonics, our ears are limited in their ability to distinguish extremely high or extremely low sounds. Of this also Messrs. Walker have kindly provided two illustrations. In the one case a large organ-pipe of soft tone can be used as a basis for an extemporisation in almost any key. In some keys it may sound not quite satisfactory as a tonic pedal, but the average ear is incapable of saying what is wrong. In the other case an extremely small pipe, which goes almost beyond the range of useful musical tones, can practise a similar deception. Many experiments of this kind can be made conveniently upon a pianoforte: even when the extreme treble and bass strings are accurately tuned and give good tone it is very difficult to judge the actual pitch.

There is a good deal of misconception as to

DIAGRAM G.

THELWALL'S NOTE FOR NOTE NOTATION



the real pitch of voices, owing mainly to differences of quality. There is a small but very persistent group of vocal trainers that is firmly convinced that the adult male voice covers the same range as the female and not the octave below. One lecturer recently undertook to sing the high soprano C; after painfully climbing up the scale through the tenor octave he reached the high tenor C, and stopped. The audience called on him to finish his task but he said he had already done so, and nothing would convince him that he was not really giving the C of 1024 vibrations. He was no doubt deceived partly by the inaccurate, conventional notation, and partly by the overtones of a tenor voice in its bright top octave. A well-known concert vocalist who fills important engagements to-day labours under the same delusion; and another tenor known to myself has such a peculiarly brilliant top A that it is difficult for a listener to believe sometimes that there is not a treble-voice sounding the upper octave at the same time. The effect of bright reedy tone can be tested with choir-boys. If the choirmaster sing the C of 256 vibrations with his ordinary full voice and asks them to give the same sound they will almost invariably sound the octave above; but if he hum the same note very softly on the vowel "oo," they will most probably pitch upon the proper octave.

Hazy conceptions of pitch obtain currency in many other connections. Few people are aware how high a boy whistles. The pitch of large bells is usually thought to be lower than the reality, while, on the contrary, there are bells of bad tuning which give the impression of being higher than their true pitch. Mr. W. W. Starmer, who has devoted much time to the subject of bells, kindly furnishes some measurements and weights of well-known bells, with their accurate pitches. After stating that a bell weighing as much as two tons, if made on the most satisfactory proportions, will produce a sound no lower than middle C, Mr. Starmer quotes the following particulars of existing bells:—

Famous bell of Erfurt, diameter, 8 ft. 4 in.; weight, 15 tons 15 cwt.; note, tenor E. Lavenham bell, diameter, 4 ft. 4½ in.; weight, 24 cwt.; note, middle D. Beverley bell, diameter, 5 ft. 1 in.; weight, 41½ cwt.; note, middle C. St. Saviour's, Southwark, diameter, 5 ft. 6 in.; weight, 52 cwt.; note, middle B flat. Big Ben, diameter, 9 ft.; weight, 13 tons 11 cwt.; note, about tenor E. It has probably astonished many listeners to hear that such large bells have so comparatively high pitches.

The orchestral timpani have also been misjudged as to pitch. These drums, as all musicians know, give definite notes, unlike the bass drum, which only makes an earth-shaking noise. But a good many listeners are of opinion that the kettledrums sound an octave lower than they really do.

Amongst the wind-instruments there are some which are deceptive by reason of their brightness, others on account of their dullness of tone. In the former category we find most of the brass, while on the other hand some of the large-bore brass instruments, when played softly, give an impression of depth even beyond that which they undoubtedly possess. It is not commonly realised that the tube-length of the French horn in F is the same as that of the mighty-toned bass-tuba. The volume of tone produced by the latter certainly gives cause to imagine its pitch to be different from that of the former even when they play exactly the same notes. The low notes of the clarinets, and especially of the tenor and bass varieties, also give a fine impression of depth beyond the actuality. If time permitted there is hardly a limit to the interesting comparisons of this kind which might be drawn, but I must refrain.

CONCLUSION.

I reserve to the last a brief appeal that if possible we may secure some tangible result from to-night's discussion on the first half of the paper. I have spoken strongly about the transposing instruments, because the matter is really one of the greatest importance in musical education. If I have not succeeded in convincing you of the feasibility as well as the desirability of abolishing the present system, or want of system, I must plead lack of time as the excuse. There is no lack of proofs ready to hand, if more are needed to back up my statements. Having been mixed up with orchestras and orchestral players from early boyhood, my convictions have been formed by practical experience, and are by no means the result of mere theorising. Dr. Saint-Saens and other composers are already making tentative experiments in the direction of treating some of the wind as non-transposers, but there is really no need for such caution, and this distinguished Society, as an impartial body, would perform a notable service if it could see its way to inaugurate a conference to discuss the situation. Without attempting at

once any radical change in the notation itself, an agreement to use the notation only in a rational and unambiguous manner would be an achievement for which musicians would owe to the Society of Arts a debt of the deepest gratitude.

DISCUSSION.

Mr. BLAIKLEY thought all that Mr. Borland had said with regard to the difficulties incidental to the customary way of writing for transposing instruments was perfectly true. But, as regards musicians clinging to the system from a desire to make the musical profession a close corporation, he felt that Mr. Borland was in error, and that the transposing system had come about through the desire to make music easy to the actual performer. It must be remembered that the thing the player wished his written part to show was not the particular pitch in the general scheme of the notes allotted to him, but signs for fingering, and by the transposing system he was relieved from the confusion of learning various sets of fingerings for the same written sign. There was a great deal to be said on both sides.. He noticed that Mr. Borland, in his remarks with respect to absolute pitch as it stood at the present day, said that the military pitch was a semitone above the present orchestral pitch. He understood, of course, that Mr. Borland referred to the philharmonic pitch of the year 1896, which roughly corresponded to the diapason normal. The present military pitch was certainly not a semitone above that. He was speaking, of course, of the authorised military or Kneller Hall pitch. That was about two-thirds of a semitone above the present concert pitch. That this pitch was often exceeded he must admit; but that excess was not authorised. There was no authorised pitch in this country above the Kneller Hall pitch. Mr. Borland, no doubt, knew all these things.

Mr. BORLAND said that he had the permission of the Chairman to reply to that point at once. There were many unauthorised varieties, but the word "unauthorised" was in the paper already. Of course, he was fully aware that the Kneller Hall pitch was not a full semitone above, but they were always going up.

Mr. F. W. FLETCHER said that he should like to support Mr. Borland's suggestion that the Society of Arts might very well arrange a conference both as regarded notation and the question of pitch. In the Exhibition of 1887 there were very many examples exhibited of various notations. With regard to the notation, one of the greatest difficulties appeared to him to be the change from a minor to a major key. If they were playing in B minor and they got a sudden change into B major that seemed to be as difficult in tonic solfa as in the ordinary notation; and in the tonic solfa they had the changes coming one after another, whereas they could overcome many of the difficulties in the old-fashioned notation. As regarded the illustrations that had been given he saw the same difficulty. There would be just the same difficulty in reading rapid changes of key in the new method as in the other. He should like Mr. Borland to explain how various changes of key in this notation were shown. As far as concerned orchestral notation, he thought that there might be a very great improvement in that. The paper had been very instructive, in giving them some idea of the difficulties which they must encounter in arranging a score.

Mr. W. H. THELWALL wished to thank Mr. Borland for the assistance and sympathy which he had given him in bringing forward his musical notation. Musicians were very conservative, and did not like the idea at all of any change of notation. With regard to the question of change of key he might illustrate what he had to say in this way. Of course in every key all the twelve notes of the octave were freely used by composers, and if they wished to give a definite idea of what the key was they must confine themselves for a bar or two to the notes of one of the diatonic scales. Of course, in the notation which had just been shown, each major scale had its own particular lines and spaces on the stave, and directly the performer found that those particular lines and spaces were prominent he knew what key he was in. But, beyond that, by an exceedingly simple device, the tonic for the time-being could be shown so that anyone could recognise it. As each line and each space represented a definite note of the octave, all that was necessary was to put a particular mark on the line or the space that happened to be the tonic for the time being. What he proposed was that a large square mark should be put upon the line or space which was the tonic when the composition was in the major mode. When the composition was in the minor mode he put a triangular mark. If the composition began in the key of F sharp, the mark would be put on the lowest line. If it then went into C sharp the mark would be put on the fourth space. Thus by this system they had, he believed, the advantage of both relative and absolute pitch being shown far more clearly than in any other system. He might refer to ledger lines. Lines which were apparently ledger lines occurred in his system, but they were really lines borrowed from the next stave; and the signification of the notes on the ledger lines was exactly the same as that of the notes on the stave. The particular stave intended would always be shown by putting

a figure on the middle line, the octave of which middle C was the centre. Then they could write for any instrument in the orchestra in its true position by simply putting the right figure for the octave. From his point of view the present system involved an enormous waste of time. The new method was so simple that the pupil might learn the way in which every note in music was represented in a couple of hours fairly well, or certainly in a very short time. He had only to learn the position of twelve notes and the meaning of the numbers of the octaves. In the old notation the pupil had to become absolutely familiar with four or five hundred different signs before he could read. He had found plenty of cases of notation which practically no musician could read. If those pieces were written on the new system they could be read with perfect ease. Of course the notation was a large subject, and the author could not deal fully with it in the time. It had been very carefully thought out, and had been submitted to a number of very eminent musicians, and the representation of equal temperament was considered by them perfectly satisfactory.

Mr. George Langley said that as a professional musician he should like to throw what little weight he could into the scale in favour of the change with regard to the simplification of scores. It was very confusing when there was a chord to have to look at the different keys of the transposing instruments to realise what were the actual notes. It might be argued that in many cases the notation for the transposing instruments might be necessary to the players themselves, but that was no reason really why the notation should be retained in the scores. Therefore, he would say that in that case they might have the actual notes as they sounded. With regard to the question of realising the twelve chromatic notes under the system, he did not quite go with Mr. Borland. Let them take one chord. Take the following notes, reading upwards: A flat, C, E flat, and G flat. That was a well-known chord of the dominant seventh. They would play in the key of D flat, and all at once they changed that enharmonic G flat to F sharp, which made a chord of the augmented sixth. They resolved it into the key of C minor, and the mental effect was quite changed. This showed that the F sharp and the G flat, although absolutely the same notes on the piano, were different notes in theory, and that was his contention. Although they had equal temperament they translated mentally every note. He had much enjoyed Mr. Borland's paper, and he hoped that the points which he made with regard to the score would be enthusiastically received.

Mr. T. R. Croger said that as the greater part of the paper was devoted to orchestral matters, he should like to refer to two or three points. The great offenders in the score, or the transposing instruments that gave so much trouble, were the clarinets. The flute, the piccolo, and the oboe were all right, for they were octave instruments. They sounded note above note in the octave, but the clarinet being a straight tube, instead of a parabola, gave twelfths. Therefore they did not get the octave rise, but a rise to the twelfth. This made it exceedingly difficult for clarinet players to play in keys which had a great number of flats and sharps, and that was why several instruments were used. If they could play always with a C clarinet, there would be no difficulty in transposition; but it was not satisfactory in notation to play many sharps or flats with an instrument with long keys. The consequence was that there were three of the instruments in the orchestra. The reason why they had to be changed was that, for some peculiar reason, the B flat was very much better to play upon, but if they had to play a lot of sharps it was difficult. If the strings were played in two sharps the B flat clarinet had to be played in four sharps with an awkward fingering. People wrote in the good old days, say, in the key of G, but now the player did not know where he was from bar to bar. He did not know the tonality of a work which was constantly changing, and the clarinet player was constantly picking up one instrument and putting it down and picking up another. If all the clarinets could be put in C, there would be no transposing. But the worst offenders were the horns. The trumpets were in a similar case, but not nearly so bad. The horn was originally a hunting horn, and they played a few open notes; but now the moderns treated it as a chromatic instrument with all the semitones in it. With regard to the clefs, he had a communication yesterday from a man in the north of England who belonged to a brass band, and he played an instrument which curled round his shoulder from the treble clef, and thousands of brass players did that. With regard to the organ pipe yonder, when Mr. Borland played the low C, he (Mr. Croger) failed to hear that note at all, but he heard F. If anybody could devise a means by which a horn could be rendered a non-transposing instrument, he would do more to settle the difficulties of the score than anything else.

The Chairman said that he was sure that they would all agree with him in thanking Mr. Borland for his excellent paper. Those who occasionally consulted a score knew how complicated it was, but probably none of them had had such a dreadful picture before them as Mr. Borland had held up to-night. Of course, notation was a great difficulty, especially to young musicians. There was a story of an eminent musician of modern times who was almost self-educated, and he conducted a band in his village, and then he was induced to write something for his band, which he did. But the result was horrible, for he did not know that the instruments transposed. This composer

was Dvorák! Of course it must be borne in mind, for the comfort of Mr. Thelwall, Mr. Borland, and many others, that the art of notation had been one gradual development, and it had gradually gone on till it had got to the present system, or what he might call the vernacular. Mr. Borland had said that there was probably a professional wish to keep the art close, but he (the Chairman) could not say that he agreed with that view, for the art of music had a much simpler notation now than it had many years ago. Probably notation was still in a state of development, and they might live to see Mr. Thelwall's method adopted. The great difficulty was that there was a large amount of music which had something more than antiquarian interest, which would be shut away from people in a generation or two if the existing notation was abolished altogether. To follow this music people would have to learn, in fact, two languages. Then there was the question of the expense of bringing out works in the new notation. He had the pleasure of a long interview, a few weeks ago, with Mr. Thelwall, who was good enough to explain his system, and he made a very ingenious remark. He said that the pianola was getting very common, and it answered the purpose of a musical instrument maker to make copies of all the standard works for the pianola. No doubt, directly they got into the new notation, Beethoven's symphonies would be published in it. As to transposing instruments, they did not number their staves as Mr. Thelwall would do, but it was perfectly understood what pitch a piccolo, for instance, was playing in.

The vote of thanks having been carried unanimously,

Mr. BORLAND, n reply, said that what had been said about the clarinet was also in his paper. It was for makers to devise some system whereby a clarinet would play in any key in the same way as an oboe. In fact, a few accomplished players played everything on the B flat, that in C being hardly seen in the orchestra now. The A natural instrument was also disappearing. He fully realised that for less accomplished players the transposing system was desirable; but still it need not be kept in the scores. The question of the pitch of Kneller Hall he had already mentioned. Mr. Langley had referred to the augmented sixth and the dominant seventh. The difference was no more than the difference between D in the key of D, and D in the key of G. They were totally different things. We called them D simply because that special note had not usually any other name. With regard to musicians keeping music a close corporation, he knew, of course, that in a general way it wes not so, bat there was a little of it sometimes. He heard a distinguished man say that he thought it a good thing to have some stumbling blocks to keep dabblers out. On the other hand there was so much difficulty in the real music itself, after they had got past notation, that they did not need to invent other difficulties to make the subject still more difficult than it would naturally be. That would be like building a high wall round Charing-cross Station, so that they could judge of the earnestness of travellers by requiring them to climb over the wall. Sufficient difficulties already existed. He was sorry to differ from Mr. Croger, but he thought that the horn was not the difficulty. The clarinet was the real difficulty in the score. The horn having a chromatic scale and very simple mechanism, there was no need that it should be treated as a transposer. As to the reference which Mr. Matthew had made to the music now existing and the new notation, it was certain that, if there was a demand for the existing music the publishers would print it in the new system. The question was whether the new notation was all that was desired, or would do all that was wanted. That could be only judged by practical experience. It must have the test of time, the same as everything else.

DISTRIBUTION OF THE WORLD'S INDUSTRIAL POPULATION.

Quite apart from their value in relation to the fiscal question, the Blue-books numbered Cd. 1761 of 1903 and Cd. 2331 of 1904, are of considerable value as affording to the student of industrial questions a compilation of information on various subjects. The sociologist will in the pages of the second book find much that is of interest concerning the consumption and cost of food in workmen's families in the United Kingdom, course of house rents, cost of clothing, fuel and lighting, and so forth, and an examination of the fluctuations in employment recorded will interest both employers and employed. The course of pauperism in some of the chief commercial countries and its relation to emigration are also important subjects which are dealt with. Of wide general interest is the section devoted to the distribution of population engaged in the principal industries throughout the chief countries of the world. The notes and tables given throw a useful light on the industrial composition of the populations of various countries, and on recent changes in such compositions. It must not, of course, be assumed that the distribution of output corresponds accurately to the distribution of producers, because of the differing productive value of the artisan in different countries; for instance, the Lancashire cotton operative is a very different unit as regards output from the cotton operative in a backward country like Russia, or the negro operative in the factories springing up in the cotton growing districts of the United States. It must also be borne in mind that a unit of population does not represent a constant unit of output over a period of

years. With improvements in mechanical devices, and their extension into common use, the output per head of population is continually increasing, though more rapidly in progressive than in unprogressive countries, and more rapidly in some groups of trades than in others.

Taking the industries in the order given in the Tables, and collecting for each industry the numbers of people engaged, we get the following figures for the principal countries, the year given in brackets being that of the latest year of computation :—

Cotton Industry.

	No. of Operatives.
United Kingdom (1901)	606,200
Russia (1897)	360,928
German Empire (1895)	254,546
France (1896)	186,900
Italy (1901)	171,126
United States (1900)	331,473
British India (1903)	178,444

In regard to the United Kingdom, there has been a decrease of 17,400 since 1891, Russia shows an increase of over 108,000 since the 1887 census, Germany an increase of 44,000 since 1882, France a decrease of 90,000 since 1866, and the United States an increase of nearly 95,000 since 1890. In regard to British India, the increase has been over 57,000 during the last ten years. In all these countries, including those in which the number of operatives has declined, there has been a continuous increase in the consumption of raw cotton.

Woollen and Worsted Industry.

United Kingdom (1901)	252,400
Russia (1897)	150,620
German Empire (1895)	262,260
France (1896)	213,900
Italy (1901)	79,391
United States (1900)	135,185

The figures for the United Kingdom again show a decrease since 1891 (its amount is 51,300 persons), while Russia, Germany, and the United States again show increases during the period intervening between the last census and its predecessor.

Flax and Linen Industry.

United Kingdom (1901)	108,700
Russia (1897)	52,560
German Empire (1895)	105,716
France (1896)	127,200
United States (1900)	3,411

A numerical decline in the case of the United Kingdom again occurs; the Russian figures show an increase, the French are stationary, while the German figures show a decline greater than the British.

Silk Industry.—So far as silk is concerned, the British and German figures show a decline, the Swiss and American an increase, while French figures are stationary. Very little value should be placed upon the French returns, as owing to the length of the period between the censuses quoted, important intervening fluctuations are probably omitted. The latest returns as to the number of workpeople engaged in the silk industry, are as follows :—

United Kingdom (1901)	40,490
Russia (1897)	38,229
Germany (1895)	69,801
France (1896)	159,500
Italy (1901)	184,164
Switzerland (1901)	33,506
Austria (1900)	23,602
United States (1900)	72,438

In regard to all these textile industries, the figures would have been of greater comparative value had it been possible to compute the average consumption of raw material per worker.

Mining Industry.—As regards the occupation afforded by the mining of coal and metals, the returns are considerably fuller than those given relative to the textile industries. In many cases the figures are given for several years. In the following table the numbers given are generally more up to date than in the previous Table, the latest year of computation being cited in each case :—

United Kingdom (1903)	871,889
Russia (1900)	376,541
German Empire (1902)	608,872
Belgium (1902)	135,749
France (1902)	180,658
Spain (1902)	87,508
Italy (1902)	63,270
Austria (1902)	157,322
Hungary (1902)	73,713
United States (1902)	518,197

In all these countries there have been marked increases. Taking in each case the last ten years, the increases have been as follows :—United Kingdom 133,000, Russia 173,000, Germany 186,000, Belgium 15,000, France 34,000, Spain 32,000, Italy 3,000, Austria 25,000, Hungary 18,000, and the United Stases 176,000.

Iron and Steel and Manufactures thereof.—In this case we have to fall back upon figures collected from miscellaneous reports in place of yearly returns :—

United Kingdom (1901)	1,248,940
Russia (1897)	432,497
Sweden (1901)	59,705
German Empire (1895)	1,114,509
Belgium (1901)	22,919
France (1896)	573,058
Italy (1901)	100,613
Austria (1900)	369,595
Hungary (1898)	75,942
United States (1900)	1,149,762

The only countries challenging the British lead in this section are Germany and the United States, both of whom have much larger populations. The increases in the chief of the above mentioned countries have been as follows:—United Kingdom, 267,000, since 1891; Russia, 168,000, since 1887; Germany, 307,000, since 1882; Austria, 86,000, since 1890; and the United States, 354,000, since 1890. This section, in its minutiæ, deserves special study by those interested in engineering industries generally. Not only are the numbers employed in specific branches of the industry given in most cases, but also their apportionment between different states or difficulties. In the case of the United States 34, in France 82, in Germany 12, and in the United Kingdom 18 sub-divisions are providing. Their contrasting in the pages of the *Journal* is, we fear, impossible (even were space available), on account of the different scopes of the various classifications. The figures already quoted suffice to shew the importance of the engineering industries to Great Britain, especially when it is borne in mind that the only two countries in which over a million citizens are so employed, contain vastly larger populations.

Leather Trades.—Under this heading are included saddlery, boot, shoe, and glove making. The following are the figures of the leading countries:—

United Kingdom (1901)	384,096
Russia (1897)	36,990
Holland (1899)	39,638
German Empire (1895)	555,438
France (1896)	322,900
United States (1900)	328,613
Italy (1901)	407,490
Austria (1900)	237,610
Australasia (1902)	17,709

The following are the chief gains and losses in the numbers of artisans employed. United Kingdom, loss of 22,000 since 1891; Russia, increase of 15,000 since 1887; Germany, increase of 13,000 since 1895; United States, increase of 47,000 since 1890; and Austria, decrease of 15,000 since 1890.

Paper Trades.—The heading includes paper manufacturers, stainers, envelope makers, paper-bag makers. The following are the chief figures:—

United Kingdom (1901)	74,150
Russia (1897)	46,190
Germany (1895)	85,104
France (1896)	51,600
United States (1900)	72,159

In this industry the British figures include an increase of 16,000; Russia, an increase of 27,000; Germany, an increase of 27,000; and the United States an increase of 31,000. In each case the increase stated is that which has happened since the preceding censuses, the dates of which have been several times recited.

Glass Industry.—The following are the principal figures:—

United Kingdom (1901)	32,929
Russia (1897)	37,543
Germany (1895)	58,221
Belgium (1900)	22,780
France (1896)	38,500
Austria (1900)	43,069
United States (1900)	61,164

The comparative gain or loss since the previous enumerations has been as follows:—United Kingdom, 4,000 increase; Russia, 16,000 increase; Germany, 20,000 increase; Belgium, 2,000 increase; Austria, 3,000 increase; United States, 11,000 increase.

Brick, Tile, and Pottery Industries—The comparative figures are as follows:—

United Kingdom (1901)	135,618
Russia (1897)	88,178
Germany (1895)	306,919
France (1896)	80,100
United States (1900)	122,227

There have been the following increases since the previous collecting of figures:—United Kingdom, 26,000; Russia, 49,000; and Germany, 80,000; in the United States there has been a decline of 9,000.

Chemical Trades.—The following are the figures of the leading chemical manufacturing countries:—

United Kingdom (1901)	58,232
Russia (1897)	33,148
Germany (1895)	97,470
France (1896)	42,900
Italy (1901)	15,958
United States (1900)	140,515

In none of the above-named countries has there been any decline in the number of artisans employed in the chemical industries. The increase in the United Kingdom has been 17,000; in Russia, 12,000; in Germany, 40,000; and in the United States 62,000.

Agriculture.—No detailed Tables are given in this respect, but in regard to the United Kingdom, Germany, and the United States the following estimated figures are given:—

	Number of Persons.	Number per 10,000 of population.
United Kingdom—		
1901	2,054,000	495
1891	2,266,000	601
1881	2,479,000	711
Germany—		
1895	8,045,000	1,554
1882	8,064,000	1,783
1875	not stated	not stated
United States—		
1900	10,187,000	1,348
1890	8,380,000	1,338
1886	not stated	not stated

The above Table shows that the proportion which the agricultural population bears to that of the entire country is three times greater in Germany, and two and three-quarter times greater in the United States, than is the case in Great Britain and Ireland.

Summary of Preceding Specified Manufacturing Industries.—From the summary Tables given on

pages 436-438 of the Blue-book, the following totals have been compiled, giving the estimated populations engaged in these industries at three different dates:—

	Number of persons.	Number per 10.000 of population.
United Kingdom—		
1901	4,914,000	1,185
1891	4,249,000	1,126
1881	3,866,000	1,109
Germany—		
1895	4,694,000	907
1882	3 686,000	804
1875	2,535,000*	573*
United States—		
1900	4,240,000	562
1890	3,356,000	536
1880	2,082,000†	415†

* These figures are incomplete because of the omission of the building trades.

† These figures do not include proprietors and members of firms.

Proportionately to population, manufacturers provide more employment in the United Kingdom than in either of her two chief commercial rivals. This proportion has latterly increased at a slower rate than in Germany or the States. Nevertheless, an increase has taken place, so far as the twelve specified industries are concerned. For a complete comparison other smaller industries need to be enumerated and included. On that account too great a reliance should not be placed upon this last Table.

EDUCATION IN IRELAND.

The Irish people have suffered greatly from the want of an efficient national system of education. Religious and racial feuds have retarded reforms, and the Imperial Parliament has been slow to take the necessary steps to ensure a rational and adequate education of the people. But, as the seventieth report of the Commissioners of National Education in Ireland, just issued, shows, there is progress, slow but distinct, towards the standard of more advanced countries. At the time of the appointment of the Commission in 1831, Irish primary education was at a very low ebb. There were comparatively few schools, few trained teachers, no suitable school books, and no general, or approved system of instruction. Twenty years later, the condition of education had improved but was still very backward. The population of Ireland was then 6,552,385, and 47 per cent. of the inhabitants of five years old and upwards, could neither read nor write. In 1891 the population had fallen to 4,458,775, and only 14 per cent. of its inhabitants of five years old and upwards could neither read nor write. Nor must it be forgotten that it was the younger and better educated who emigrated to the number of 2,000,000 during this period, while the illiterates were persons who were too old to leave their homes. Again in 1871, of children of five years and under ten years of age, only 20 per cent. could read and write. In 1901, the per centage was 53·5. The growth of the national schools and attendance are shown in the following tables:—

	1861.	1901.
Population	5,798,967	4,458,775
National schools	5,830	8,692
Average attendance	284,726	482,031

And so with the national teachers—

	1861.	1901.
National teachers	6,500	11,897
Partially trained	3,048	5,588
Fully trained	3,452	6,309

Of the teachers now serving in such national schools 57 per cent. are trained, a much larger percentage than is found in England and Wales.

The number of illiterate voters who presented themselves at the last General Election showed that the condition of elementary education in Ireland was still very defective, and it was sought to diminish illiteracy amongst these classes by modifying the rules for evening schools so as to admit adults. The experiment has been more successful than was expected. In 1900 there were only 21 evening national schools, in 1903 there were 1,263.

But if there has been improvement in these ways in recent years much remains to be done in other directions. One of the most serious defects in the national system is the wretched condition of a large number of the school-houses. For many years past the Commissioners have been urging successive Governments to make adequate provision in the annual estimates for this purpose. As a result of these representations an Inter-departmental Committee inquired into the whole question in August, 1902. "This Committee," says the Commissioners, "reported to the Government, but up to the present neither a copy of their report, nor the decision, if any, arrived at by the Government and the Treasury has been communicated to us; and nothing has been done by the Executive to give effect to the recommendations of the committee. This inaction has not merely been indirectly injurious to the provision of suitable school houses, but it has actually brought to a standstill in hundreds of cases the work of building, owing to the desire of managers to await the publication of the new plans and scales of grants, and it has caused us to refrain from compelling managers of unsatisfactory schools to apply for building grants." The Commissioners are strongly of opinion that unsatisfactory school buildings are largely responsible for the slow rate of educational progress, and for the irregular attendance of pupils. The arrangements for heating, lighting, and cleaning the school houses are, as a rule, unsatisfactory except in the case of the model schools, schools vested in the Board, convent schools, and other large schools. In very many schools, especially those situated in remote or impoverished localities, these matters are almost entirely neglected.

The average daily attendance at these schools as compared with the number of pupils on the rolls is

low. It is only 482,489, or about 65 per cent. of the number on the rolls, as compared with 85 per cent. in Scotland. The attendance is, however, slowly improving from year to year, and it must be remembered that while attendance is compulsory throughout Scotland, only a comparatively small portion of Ireland is under the operation of the compulsory law. Moreover, the school houses in Scotland are better maintained than in Ireland, and the regularity of attendance of children is stimulated by prizes. In Ireland there are no funds for the awarding of school prizes, and local interest in education is much less keen.

The religious denominations of the pupils on the books on the 31st December, 1903, were as follows:—Roman Catholics, 74·2 per cent.; Episcopalians, 12·1 per cent.; Presbyterians, 11·5 per cent.; Methodists, 1·3 per cent.; the rest, 0·9. In his recent book on "Rome in Ireland," Mr. Michael McCarthy says that "Education has become almost entirely sectarian in the Irish primary or national schools," and the official figures show that there is substance in the statement. The percentage of schools having Roman Catholic and Protestant pupils in attendance steadily dwindles. In 1893 it was 45·5, and year by year without a break it has grown smaller until in 1903 it was only 33·1. And although there are in Ireland 2,853 schools attended by pupils of both denominations, 2,000 of these schools are under exclusively Roman Catholic teachers, and only a trifle over 5 per cent. of the pupils are Protestants. The remaining 853 schools are under Protestant teachers, and the percentage of Roman Catholic pupils is a little over 9 per cent. There are only 30 schools under conjoint Protestant and Catholic teachers, the attendance at which is 30 per cent. Protestant and 70 per cent. Roman Catholic. The following table is instructive:—

Religious Denominations.	Clerical.		Lay.	
	No. of Managers.	No. of Schools	No. of Managers.	No. of Schools
Roman Catholic	1,190	5,773	146	175
Late Established Church	707	1,063	247	409
Presbyterian	394	711	163	212
Methodist	62	90	11	15
Other Denominations	11	19	30	36
Total	2,364	7,656	597	847

These figures show that there are 5,948 Catholic national schools in Ireland, and of these 5,773 are under priest-managers, and only 175 under lay-managers, the priest having more than thirty-nine times the power of the layman. With the Protestant schools the lay element is much stronger. There are 2,555 non-Catholic national schools, and of these 1,883 are under clergymen-managers, and 672 under lay-managers, the cleric being less than thrice as powerful as the layman.

AUTUMN RAINFALL AND YIELD OF WHEAT.

The following memorandum prepared by Mr. Shaw, the secretary of the Meteorological Council, on the relation on the yield of wheat to the rainfall for the last 21 years, has been communicated to *The Times*, by Sir Richard Strachey, G.C.S.I., Chairman of the Meteorological Council:—

In the course of an inquiry into the distribution of rainfall and other meteorological elements in the seasons of the last 21 years, a relationship has been disclosed between the autumn rainfall and the subsequent yield of wheat which is so remarkable that it deserves special notice. For the purpose of this comparison "autumn" must be understood to mean the period from the 36th to the 48th week (both inclusive) of the year as dealt with in the *Weekly Weather Report*. The 13 weeks cover approximately the months of September, October, and November, and the rainfall is that given in the *Weekly Report* for the "Principal wheat-producing districts." The figures for each year are shown in the following table; the year given is the year in which the crop was gathered, the corresponding rainfall is that of the previous autumn. The figures for the yield of wheat express in bushels per acre the average yield for England as given in the annual returns of the Board of Agriculture, rounded off to the nearest half-bushel—

Year.	Yield of Wheat.	Previous Autumnal Rainfall.
	Inches.	Inches.
1884	30	8·5
1885	30·5	5·2
1886	27	10·2
1887	*32	7·8
1888	*28	7·0
1889	30	7·0
1890	31	6·5
1891	31·5	6·6
1892	26	9·7
1893	*26	9·0
1894	30·5	6·9
1895	*26	7·9
1896	*34	7·9
1897	29	10·0
1898	35	5·0
1899	*33	7·5
1900	28·5	8·0
1901	31	7·2
1902	33	5·8
1903	*30	5·5
1904	26·5	10·4
1905	—	4·2
Mean	30·0	7·3

* Anomalous years.

The obvious general conclusion to be drawn from this table may be briefly stated; disregarding for a moment the figures marked with an asterisk, the yield of wheat goes up as the autumn rainfall goes down, and *vice versa*.

But the relation indicated is much more specific than a mere general statement would imply. It may be put into a more precise form, as follows:—With certain exceptions every inch of autumn rainfall involves a diminution of the yield of wheat for the following year by a bushel and a quarter per acre. It may be premised that the extreme variation of yield was from 26 bushels in 1892, 1893, and 1895, to 35 bushels in 1898. If the yield be computed from the autumn rainfall by subtracting from the *datum* of 39·5 bushels per acre a bushel and a quarter for every inch of autumn rainfall, the "computed yield" obtained in this way shows an astonishing agreement with the actual yield given in the official returns.

In seven years out of the 21 the agreement is within half a bushel. But perhaps the general accuracy of the relationship is more strikingly manifest if the years when the calculation fails most signally to give the yield are considered. In seven of the years the actual yield differed from the computed yield by as much as 2·5 bushels or more, on the one side or the other. These are the years marked with an asterisk in the table. Two of the seven years were 1888 and 1903, when the crops were flooded by summer rains amounting to upwards of 10 in., and the yield fell below the computed value by 2·5 bushels in each case. The two exceptional years 1887 and 1899, when the crops exceeded the computed yield by 2·5 and 3 bushels respectively, are very interesting, for, although the autumn rainfall came up to the average as regards amount, it was so irregularly distributed that there were eight weeks out of the thirteen in the one case and ten weeks in the other, when the rainfall was less than the 20 years' average, the amount for the quarter being brought up to the average by exaggerated rainfall in a few weeks. These might, therefore, be called dry autumns from a certain point of view, in spite of their having the average total rainfall, and the yield corresponds with the results for dry autumns rather than one with average rainfall. The two consecutive years 1895 and 1896 are also interesting; 1895 is memorable as the year of the extremely cold February, a truly anomalous year. Its yield of wheat was 3·5 bushels below the computed amount, but, strange to relate, the following year, which had in addition the advantage of a very dry winter, gave a yield above the computed return by 4·5 bushels per acre, as though the unused productive power of 1895 had not been lost in consequence of the exceptional cold, but stored. The two years taken together would agree admirably with the rule. The remaining exception year is 1893, a year of phenomenal drought.

Thus every year when the difference between the computed and actual yield is more than two bushels is otherwise conspicuously anomalous, except the years 1887 and 1899, and for those years the divergencies have been already, to some extent, explained. In the remaining seven years the computed yield differs from the actual yield by an amount between half a bushel and two bushels. An examination of the details of the statistics does not diminish the evidence of correspondence between the two sets of figures, but we need not consider the details here.

Various reasons may be given for regarding the autumn rainfall as likely to influence the yield of wheat; the washing of nitrates from the soil by the rain or the postponement of sowing to the spring on account of the wet are, no doubt, effective, but that all causes should combine to make the dryness of autumn the dominant factor in determining the yield, as it clearly is, is very remarkable.

The averages both of yield and of rainfall are taken over large areas; the figures are, in fact, the only ones immediately available for the purpose of such a comparison in the returns of the Board of Agriculture and the Meteorological Office respectively. What modification the induction would suffer if the inquiry were to be pursued for separate districts or individual fields has yet to be determined.

In the meantime the relationship clearly indicates a clue to such phenomena as the deficiency of yield in 1904, after the favourable seasons of that year, in the excessive autumn rainfalls of 1903; and it is sufficiently remarkable that when I first compnted the yields on the principle of deducting from 39·5 a bushel and a quarter for each inch of autumn rainfall, and extended the calculation to the years 1904 and 1905, without knowing at the time the wheat yield of either year, the computed yield of 1904, 26·5 bushels per acre, was subsequently found to agree with the actual yield, which is entered at 26·52 bushels in the official returns. This agreement at once raises the interesting speculation whether the exceptionally large yield of 34·5 bushels per acre for 1905, computed from the small autumn rainfall of 1904, will be borne out to the same degree of accuracy. At any rate, it seems clear that in the absence of some extraordinary abnormality of the seasons between now and next September the yield of wheat for England must be unusually large.

W. N. SHAW.

THE GROWTH OF LOCAL EXPENDITURE.

The growth of expenditure by local authorities has of late years been very rapid, and the Local Taxation Returns just issued give no indications of slower expansion. They afford much occasion for thought and even anxiety. In the financial year 1884-5 the total expenditure (including expenditure defrayed out of loans) was £44,053,904, in 1902-3 it had risen to £92,882,545; that is to say in less than twenty years it had much more than doubled. But this rapid growth is slow as compared with that of expenditure defrayed out of loans. In 1884-5 this expenditure was £9,853,795, in 1902-3 it had risen to £36,968,198; in less than twenty years it had nearly quadrupled. The total expenditure which stood at £53,907,699 in 1884-85, had risen in 1902-3 to

£128,968,743. Examination of the details of loan expenditure show the main increases to be as below:—

	1884-5. £		1902-3. £
Electricity Supply	—		4,161,794
Highways and Street Improvements	2,399,688	..	6,228,760
Lunatic Asylums	260,858	..	1,124,244
Works, Open Spaces, &c.	92,200	..	804,540
Public Buildings and Offices	170,773	..	386,604
Schools	1,385,508	..	2,312,051
Sewerage	985,385	..	2,502,611
Tramways	108,517	..	4,675,591
Waterworks	1,231,598	..	4,304,959

The amount of the outstanding loans has more than quadrupled in the last thirty years, standing at £92,820,100 in 1874-5, and at £370,607,493 in 1902-3. The returns distinguish as far as practicable authorities acting for areas which were—(1) Metropolitan, (2) extra-metropolitan but wholly urban, (3) partly urban and partly rural, and (4) wholly rural. Taking 1874-5 and 1902-3 as the years of comparison, the increases under these several heads are as follows:—

	1874-5. £		1602-3. £
Metropolitan	21,007,799	..	67,518,225
Extra-metropolitan, but wholly Urban	61,516,173	..	270,042,566
Extra-metropolitan, partly Urban, partly Rural	10,113,975	..	28,621,641
Wholly Rural	182,163	..	4,428,061

It will be seen that the increase in the "Wholly Rural" expenditure has been comparatively much more rapid than elsewhere, and that there has been an increase in "Extra-metropolitan, but wholly Rural" of no less than £208,526,403.

Gross estimated rental and rateable value show remarkable increases, but nothing like the growth of expenditure:—

England and Wales.	1874 75. £		1902-3. £
Gross estimated Rental	136,408,462	..	231,089,809
Rateable Value	115,646,631	..	191,106,528

In the metropolis the growth has been proportionately larger:—

Gross estimated Rental	25,148,033	..	48,895,764
Rateable Value	20,672,765	..	40,677,589

It follows from the foregoing figures that the burden of the rates has become much heavier. In 1874-5 the estimated population of England and Wales was 23,724,834, and the average amount per head of population of public rates raised was 16s. 2d., in 1902-3 it had risen to £1 10s. 6d. In the same period the average amount, per head of population, of loans outstanding had increased from £3 18s. 3d. per head to £11 4s. 8d. If London alone is taken the figures show that London has relied less upon loans than the Provinces. The Londoner pays nearly three times as much in rates as he did thirty years ago, as from £1 4s. 11d. in 1894-5 to £3 0s. 5d. in 1902-3; but the average amount per head of population of loans outstanding has not very much more than doubled, as from £6 2s. 7d. to £14 14s. 11d. If Government grants and Local Taxation Duties and other sums received from Imperial funds by local authorities are considered, it will be found that the average amount per head of population in London has increased from 2s. 11·3d. in 1874-5 to 9s. 5·0d. in 1902-3, and in the rest of England and Wales from 1s. 1·9d. to 7s. 6·3d., whilst the average amount per fund of rateable value has increased in London from 5·9d. in 1874-5 to 1s. 0·7d. in 1902-3, and for the rest of England and Wales from 3·0d. to 1s. 5·1d. The principal purposes for and in respect of which the local authorities of England and Wales received moneys from Imperial funds, and taking the greatest increases in the thirty years, are shown below:—

	1874-5. £		1902-3. £
Administration of Poor Law and Relief, &c.	178,271	..	1,061,873
Maintenance of Lunatics	180,536	..	766,066
Education (elementary and others)	69,677	..	5,234,959
Police	1,187,399	..	2,393,514
Salaries of Medical Officers, Sanitary Inspectors, &c.	50,572	..	154,326
In respect of the deficiency caused by the Agricultural Rates Act, 1896, in the produce of rates	—	..	1,328,019
Under provisions of Local Government Act, 1888, in aid of rates	—	..	1,815,823

The total grants incurred in the period advanced from £1,681,399 to £12,849,284. It will be remembered in connection with the outstanding loans of the local authorities that the majority of those owing for harbours, piers, and docks are not charged on the rates. Others, such as those incurred for waterworks, gas works, and markets are primarily charged, in many cases, on the revenues of the undertakings for which they have been raised, and constitute a charge on the rates only in the event of such revenues proving insufficient to meet the amounts payable as interest on the loans, and the amounts required to be provided for the repayment of the loans.

PAUPERISM IN TOWN AND COUNTRY.

The pauperism returns for 1904 show that the increase of indoor pauperism, both actual and proportionate, in the year was considerable, and that for the quarter ended December 31st, it was higher than at the corresponding date in any of the preceding forty years. But the most striking fact to be learned

from the tables is the comparative growth of London pauperism. If the country—that is to say England and Wales—as a whole, is taken, we find that although pauperism has increased in the last three years—as from a ratio per 1,000 inhabitants of 21·8 in 1901, to 24·2 in 1904—taking indoor and out-door combined it was lower in 1904 than in any year earlier than 1890. If the paupers had borne the same proportion to estimated population at the end of December in 1904, as they did in the same period in 1874, 1884, and 1894 respectively, the numbers would have been—in the same proportion as 1874, 1,067,935, instead of 816,216; 1884, 907,564, instead of 816,216; 1894, 821,557, instead of 816,216. But if we limit the review to London, much less satisfactory figures are revealed. Taking indoor and out-door pauperism combined, the ratio per 1,000 inhabitants—26·7—is higher than for any year since 1874. And if the paupers had borne the same proportion to estimated population in the last week of December, 1904, as they did in that week in 1874, 1884, and 1894, it would be found that the position has worsened instead of bettered as is the case with the country as a whole. The numbers would have been as follows:—In the same proportion as in 1874, 132,065 instead of 124,409; 1884, 110,965, instead of 124,409; 1894, 111,371, instead of 124,409.

A large part of the increase in the last quarter—71,904—was, however, attributable to a few districts only. The net increase in London (chiefly in the Poplar and Wandsworth Unions) at the end of the quarter was 10·4 per cent. In the Croydon Union it was 78·2 per cent., and in the West Ham Union, where the numbers rose during the quarter from 14,655 to 29,776, the increase was 103·2 per cent.

The growth in indoor pauperism is very marked. Taking England and Wales as a whole, the ratio per 1,000 inhabitants—7·6—was higher in 1904 than for any year covered by the tables, that is to say, during the last forty years. And so with London, where the ratio per 1,000 inhabitants for 1904 was 16·5. In 1864 it was only 10·3. It is very noticeable, too, that whilst taking the whole country, the ratio of indoor paupers in 1904 was 7·6 and of outdoor 16·6; in London the figures are respectively 16·5 and 10·2. Turning to outdoor paupers, the figures show a decrease in the country as a whole from 37·9 in 1864 to 16·6 in 1904, and in London from 23·3 to 10·2; but whereas the ratio in 1904 for the country at 16·6 was lower than for any year prior to 1896, the ratio for London at 10·2 was higher than for any year since 1887.

WEST INDIAN AGRICULTURAL CONFERENCE, 1905.

The fifth West Indian Agricultural Conference was held at Port-of-Spain, Trinidad, from January 4th to 13th. The representatives included the principal officers connected with the chemical, botanical and educational services in the West Indies, aud the scientific officers on the staff of the Imperial Department of Agriculture, as also delegates from the Agricultural Boards and the chief Agricultural Societies.

The Conference was formally opened on January 4th by the Governor (Sir Henry M. Jackson, K.C.M.G.). In his opening address the President of the Conference (Sir Daniel Morris, K.C.M.G., the Imperial Commissioner of Agriculture) reviewing the agricultural situation, expressed the opinion that marked progress had taken place in regard to the sugar-cane, cacao, cotton, and other industries, and referred to the hearty manner in which the planters and the scientific men were working together for the welfare of the West Indies.

In the proceedings of the Conference a prominent position was assigned to the sugar-cane industry, the first subject on the agenda being the "Results of recent experiments with seedling canes and manurial experiments in the West Indies." A paper on the sugar-cane experiments in British Guiana, by Professor J. B. Harrison, was read. Professor J. P. d'Albuquerque then presented some of the results of the experimental work in Barbados, who was followed by Dr. Watts, who dealt with the experiments in the Leeward Islands. A paper showing the excellent results that had been obtained with seedling canes on a group of estates in Trinidad was presented by Dr. Urich.

The next subject brought up for discussion was the Cane-farming Industry. The discussion was opened by the Hon. B. Howell Jones (British Guiana) and Professor P. Carmody (Trinidad). Sir Henry Jackson described a very satisfactory system of cane farming in vogue in Fiji.

Other papers that were presented to the Conference in connection with this industry included reviews of the principal insect and fungoid pests of the sugar-cane, the field treatment of cane "tops" for planting, and the polarometric determination of sucrose.

Trinidad being the foremost cacao-producing colony in the West Indies, considerable interest attached to the discussion of important subjects relating to that industry. Mr. Hart read a paper dealing with experiments that are being carried on with the view of improving the health and productiveness of cacao trees. This was followed by a paper prepared by Mr. J. G. de Gannes, one of the leading cacao planters in Trinidad. Among the points raised in the discussion which received considerable attention was that of shade for cacao trees. It was apparent that widely-divergent views were held in this connection in the various islands. In Trinidad, it was considered that shade trees were indispensable; in Grenada, cacao trees did not appear to require shade; while in other islands cacao was grown both with and without shade. It was suggested by the president that a series of experiments might be carried out in Trinidad by the Agricultural Society with a view to obtaining definite information on the subject.

The attention of the Conference was next turned to the fruit industry. Mr. J. R. Bovell (Barbados) read

a short paper upon the efforts to establish a fruit industry in Barbados. The president briefly reviewed the situation, pointing out that the conditions in the different islands as regards the export of fruit were very dissimilar. Barbados enjoyed an advantage over the other islands in this matter, since Barbados was the last port of call. Experience had shown that fruit could be satisfactorily shipped from Barbados to England for eight months of the year in the ordinary holds of the vessel, without cool storage, provided the ships were adequately ventilated. Two of the ships of the Royal Mail Company had been fitted with cold storage, and, in the case of shipments by these vessels, there had been no difficulty as to the condition of the fruit on arrival. The industry could not be in an entirely satisfactory condition until all the ships had been fitted up in the same manner.

The subject of the recently established cotton industry was next brought forward. Brief statements were made by Mr. J. R. Bovell (Barbados), Dr. Watts (Leeward Islands), and Mr. W. N. Sands (St. Vincent).

Attention was also devoted to matters connected with agricultural education. The results of the efforts that have been made to introduce the teaching of the principles of agricultural science into colleges and secondary schools were reviewed by Mr. Horace Deighton and Professor d'Albuquerque (Barbados), and Professor Carmody (Trinidad). Mr. J. H. Collens, Inspector of Schools, read a paper on school gardens and school shows in Trinidad.

AUSTRALIAN PRIMARY EDUCATION.*

If there is any one point on which the Australian people are unanimous it is the right of every child to have the means of education placed within his reach, and it is very rarely that exception is taken in the State Parliaments to the cost of popular instruction, which, so far as the public schools were concerned, amounted in 1902-3 to £2,002,391, or more than 10s. per head of population. Each State has its own educational system, but all are on a secular basis, and ample provision is made for enabling children in the most remote parts of the Commonwealth to obtain a fair share of instruction. In New South Wales a public school may be established in any place where a regular attendance of not less than twenty children is guaranteed. Where the number is less a provisional school may be formed. There are also half-time schools, where twenty children, within a radius of ten miles, can be assembled in groups of ten each; and, in addition, house-to-house schools, where three or more groups are placed under an itinerant teacher. In the case of these two latter, the residents have to provide the necessary rooms, but all other charges are borne by the State. Private tutors, or governesses, are subsidised to the extent of £5 per head on an average attendance up to a maximum of £25 per annum, subject to the condition that two families share in the tuition, and that there is no State school readily accessible. In Victoria the conditions are much the same as in New South Wales, but it is not customary to start a full-time school unless there is a reasonable chance of an average attendance of at least fifteen children being maintained. Where the number of children is less, the schools are either made half-time, or the parents are paid for the conveyance of their children to school. This is found more economical than having separate schools for a dozen or less children each. Where there is railway communication the fares for school children are largely reduced. In Queensland, there must be an average attendance of thirty children to secure the opening of a State school, which may not, however, be too near one already established. In addition the residents must be prepared to pay one-fifth of the cost of erecting and furnishing the necessary buildings. A provisional school may be established where the average attendance will not be less than twelve, and the nearest existing school is not less than twelve miles distant, but the residents are required to defray one-fifth of the cost of erection and furnishing. There are also a few half-time provisional schools. In South Australia a public school may be established where an average attendance of twenty children can be maintained; and a provisional school where the attendance is under twenty, but not less than twelve. There are also half-time and special schools, the latter giving full-time instruction, although the attendance is less than twelve. The whole of the cost is borne by the State, which also pays a fair rental for any buildings provided by residents for use as provisional or special schools. In Western Australia an average attendance of twenty children is necessary to secure the establishment of a public school. Half-time schools are allowed where the aggregate attendance at the two divisions numbers sixteen. Provisional schools may be established where there is no other school within four miles and where an average attendance of from ten to nineteen children can be secured. In sparsely-populated districts house-to-house schools are permitted. Special schools may be established in places too remote from the metropolis to be regularly inspected. In these the teachers are paid salaries higher than those given in ordinary State schools of the same size. In Tasmania, a State school must have an average attendance of not less than twenty children. In thinly-populated districts, provisional schools may be formed, and itinerant teachers employed where the families are so scattered that the children cannot be gathered into a single school. Occasionally, where there is a falling off in the standard attendance, the schools receive special assistance. There are night schools in several of the States, but the number is rapidly declining. At the close of 1902 there were 7,218 State schools in the Commonwealth, with an average enrolment of 597,935, and an average

* Communicated by Mr. J. Plummer, of Sydney, New South Wales.

attendance of 455,343; the average annual cost per scholar in average attendance being £4 2s. 9d., or including cost of school premises, £4 12s. 8d. The cost is highest in Western Australia, and lowest in Tasmania. In return for this expenditure, school attendance has been made compulsory in the various States, but the law is not always stringently enforced. These figures do not include the private schools, of which there are a large number, with an attendance of several thousand children. This widely-spread diffusion of popular education explains the fact not only why Australians are such extensive readers, but also why almost every township, however small, boasts its local paper, sometimes two or more, where the population is not much larger than that of a good-sized English village.

JAPANESE INDUSTRIES.

According to recent returns there are 840 factories in Japan in which the services of chemists are permanently engaged. This number does not include only chemical factories in the narrow sense of the word, but also gas works, paper works, ceramic and lacquer works; sugar factories and breweries are not comprised within them. Of the 840 works above mentioned, steam and water-power are used in 190. There are only two establishments employing more than 500 workpeople; 86 more than 100; 207 more than 50; and in 348 more than 30 operators are engaged. Among the joint stock companies comprised in the above enterprises there are 75 for the production of salt, 43 for the production of pharmaceutical products, 95 for illuminating oils, 40 for matches, 49 for the manufacture of indigo, 4 for other colours, 4 for gas, 6 for the production of incense. The Japanese chemical industry gives employment to 38,591 workpeople, according to a report published recently by the Japanese Government, of whom 12,966 are in establishments run by steam and water-power, and 25,625 in the remaining factories. In the match factories there are five women operatives to each man. The average number of hours worked is twelve, while in the more important factories this number is reduced to ten. The average wages of the men are about 7d., and of the women about 5d. In match factories the women over 14 years of age receive from 2½d. to 6d. a day, and below that age from less than 1d. to 3d. a day. According to the latest statistics of production, the output of lighting oils in 1899, in Japan represented a value of about one million sterling; sulphate of potash, in 1898, £26,000; sulphate of soda, £86,000, and sulphuric acid, £90,000. The Japanese Government takes a very keen interest in industrial progress, and endeavours to promote it by means of industrial associations, periodical literature, and numerous educational establishments, where technical instruction is given, *inter alia*, in dyeing, lacquering, gilding, metallurgy, and brewing.

THE PEARL OYSTER FISHERY OF CEYLON.

A recent report of Mr. James Hornell, the marine biologist to the Ceylon Government, deals with the decrease among the fishable oysters since March 1902. It seems that the factors which tend to reduction in the number of oysters in any bed fall under two categories: (*a*) those which affect spat, and oysters under one or two years of age; and (*b*) those which militate against the well-being of those in or approaching the pearl-producing stage. In one particular quarter, sand disturbances effected a great deal of harm. In 1900 the whole area was thickly spread with oysters, but with every recurrent period of stormy weather these oysters suffered thinning by encroachment and overwash of sand. A subsidiary cause of destruction was the ravages of the boring sponge, *Clione indica*, which was specially active in one section, riddling the valves and sapping the vitality of the oyster by the drain it causes upon the nacre-secreting glands. Out of 400 specimens examined, 310 were affected by *clione*, leaving less than 23 per cent. as the proportion free from infection. In another case overcrowding had serious results, on account of the huge deposits of spat which fell upon the older oysters. In the first year the effects were very little marked, but "little by little, as the myriads of newcomers flourished and increased in size, the well-being of the older generation was affected, a result that showed itself first by arrest of the growth of the shell, and then by starvation, lowered powers of reproduction, and wide-spread mortality." Owing to the exceptional activity of the pearl oyster during six or twelve months of its existence, the younger generation has a great advantage over the older in the struggle for existence. The young ones mount on the topmost parts of the older ones, and intercept food particles which would otherwise pass to the latter.

Mr. Howell looks to a break in the fishery cycle in 1907, a more or less prolonged blank cycle, whereof the duration will be largely dependent upon whether large measures of transplantion be resorted to, seeing that in certain districts no fall of spat has taken place for two years.

GENERAL NOTES.

CULTIVATION OF TEA IN THE CAUCASUS.—A recent Diplomatic and Consular Report (No. 628, Miscellaneous Series), contains a memorandum by Mr. P. Stevens, His Majesty's Consul at Batoum on the cultivation of tea in the Caucasus. The industry seems to be progressing very satisfactorily, about 810 acres being under cultivation. The crop in 1902 amounted to 36,900 lbs., and increasing slightly yielded 38,700 lbs. in 1908. The prices obtained from 1s. 3d. to 5s. per Russian lb. (or 0·9 English lbs). The

cheapest qualities are purchased by the Russian Government for the use of its troops, while the medium qualities find a ready market in Moscow, Kharkoff and other towns where they are purchased by the municipalities for use in hospitals, asylums and kindred institutions. It is feared that with the increase of the area under cultivation, a great scarcity of labour will be experienced, especially at the picking seasons. At the present cost of labour, assuming an average selling price of one rouble per Russian pound, each dessiatine (2·7 acres) of properly cultivated land should yield a clear annual profit of 400 roubles, no allowance being made for administration expenses, It is pointed out that a rise of 25 per cent. in the price of the labour needed for hoeing and picking in the summer would increase the annual expenses by 65 roubles per dessiatine, proportionately reducing the profit.

RAPID TRANSIT FOR PRODUCE.—The efforts of the Italian Chamber of Commerce in London to induce Italy to accelerate the speed of trains carrying fruit and agricultural produce generally from Italy to the northern ports of Europe seem likely to be successful. It is proposed to despatch a train twice weekly from Milan to Antwerp, the trains from the rest of Italy concentrating at Milan, and covering the journey thence to Antwerp in 48 hours. The goods will then pass *viâ* Harwich to the London and provincial markets. France has already established a service of the kind from her warmer latitudes to her northern ports, and the transit trains from Vienna reach London (nearly 1,000 miles in a direct line) in 48 hours. The new railway through the Simplon Tunnel must relieve the traffic on the Mont Cenis and St. Gothard lines, and will be the fourth trans-Alpine tunnel constructed in living memory. These three routes will become more and more competitors for the traffic to the United Kingdom, the Splügen route being reserved for Germany, Russia, and Central Europe.

HIGH TARIFFS AND IMPORTS.—In reviewing the British iron and steel exhibits at St. Louis, Mr. Seymour Bell, the British Commercial Agent in the United States, mentions incidentally that American experience shows that a high tariff does not always prevent a great increase of imports. Thus, the importation of knives to the United States in 1903 showed an increase of 13 per cent. over that of 1902, though the average duty paid was 78·19 per cent., *ad valorem*. Scissors increased 27 per cent., the duty averaging 51·50 per cent., *ad valorem*. That orders are not always looked after by British manuracturers as they might be is instanced by a conversation Mr. Bell had with the representative of an American concern working under British patents. This representative declared that he had received personal inquiries from visitors from Europe for some of their manufactures. He had to refer them to the British house, who were unrepresented at the Exhibition, as his company is prohibited from selling in Europe. This was merely quoted to show how easily orders may be lost when a comparatively small outlay would show the goods to the world.

THE POPULATION OF FRANCE.—According to official statements appearing in the French *Journal Officiel*, the excess of births over deaths in 1903 was 73,106; in 1902, 83,944, or 157,050 in two years, which, added to the population as determined in 1901, namely, 38,961,945, makes the number of inhabitants in France in 1903, 39,118,995. There were 826,712 births in 1903, against 845,378 in 1902, a decrease of 18,666 and a decrease of 24,332, as compared with the average birth-rate of the last ten years. The number of deaths in 1903 was 753,606, a a decrease of 7,828 as compared with 1902, and a decrease of 54,788 in comparison with the average for the past ten years. The number of marriages recorded in 1903 was 295,996, an increase of 1,210 as compared with 1902, and 4,119 in comparison with the last decennial average. The number of divorces is steadily increasing, being 8,919, or 488 more than in 1902, and 1,758 more than the average for the past ten years. The increase in the population is not due to a larger birth-rate, for the number of births in 1903 was the smallest in the last ten years, but to a decrease in the annual number of deaths, the latter in 1903 being less than in any year since 1893, with the exception of 1897.

BRITISH TRADE WITH MOROCCO.—Mr. Vice-Consul Smith's report upon the trade of Tangier and district for 1903 mentions the possibility of furthering trade between Morocco and Great Britain in certain directions. For example, British tanners might do well to give Moorish goat-skins a trial. They are at present being exported in large quantities to America, *viâ* the United Kingdom. These goat skins are sold f. o. b. London at an average price of 9d. per lb. The skins exported from the Tangier district are reported to be the finest in Morocco, and native dealers are paying considerably more attention to the selection and preparation of them than formerly. There is again a large market in Morocco for semolina, in which Mr. Consul Smith thinks British traders should be able to compete favourably, and it might be worth their while to procure samples of the qualities required for the Morocco market. With the rapidly-increasing population at Tangier, the building trade has received a great stimulus and there is a large demand for building material of all descriptions. At present the bricks and tiles are mostly of French origin. The tables of exports and imports show that French trade made more progress in the year under review than that of any other country; German trade too seems to be gradually retrieving its position largely owing to cheap freights on German lines, and cheap handling at the German ports of discharge. But at the ports of Tangier and Laraiche the United Kingdom is still

(saving Spain) well ahead of other nations. It is a matter for regret that the Consular reports for 1903 relating to Morocco are only available to the public in February, 1905. The long delay in their publication deprives them of much of their value.

PREPARATION OF MICA FOR THE MARKET.—A paper recently read by Mr. G. A. Stonier before the Institute of Mining and Metallurgy, on "Mica Mining in Nellore (Southern India)," contained some remarks on the manner in which the material mined is prepared for the market. The mica is carried from the mines to the dressing-sheds in saucer-shaped baskets, 18 inches in diameter and 6 inches deep. The headman selects and personally splits up the good plates with a piece of hoop-iron, or with a cheap knife (with 3-inch blade and 4-inch handle, bought for a couple of annas in the bazaar), into flat pieces, free from flaw or cross-graining, about one-eighth of an inch in thickness. These pieces are passed on to women or children, who, with a knife, and a sheet of tin or zinc as a templet, mark on them as large a rectangle as possible. The cutting along these ruled lines is then done by men with ordinary European garden-shears, of which one end is firmly embedded in a block of wood buried in the ground, so that the cutting edge lies in a vertical plane. The poorer qualities of mica are treated in the same way, and the rectangles are tied into bundles of various sizes and grades according to conditions. In obtaining 143 tons of mica at Nellore, 2,097 persons were employed in 1902.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

MARCH 1.—"The British Art Section of the St. Louis Exhibition." By ISIDORE SPIELMANN, F.S.A. SIR EDWARD POYNTER, Bart., P.R.A., will preside.

MARCH 8.—"Ethics of Japanese Society." By BARON SUYEMATSU. The RIGHT HON. LORD REDESDALE will preside.

MARCH 15.—"Methods of Design in Mohammedan Art." By E. H. HANKIN.

MARCH 22.—"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

MARCH 29.—"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P.

APRIL 5.—

APRIL 12.—"The use of Wood Pulp for Paper Making." By CHARLES PHILLIPS.

Dates to be hereafter announced :—

"The Protection of Buildings from Lightning." By KILLINGWORTH HEDGES, M.Inst.C.E.

"The Supply of Electricity." By JAMES NELSON SHOOLBRED, B.A., M.Inst.C.E.

"Application of Electricity to the Location of Mineral Deposits." By ALFRED WILLIAMS.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

APRIL 6.—"The Prospects of the Shan States." By SIR J. GEORGE SCOTT, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock :—

FEBRUARY 28.—"The Manufactures of Greater Britain.—I. Canada." By C. F. JUST, Canadian Government Service in London. The RIGHT HON. VISCOUNT RIDLEY will preside.

MARCH 28.—The Manufactures of Greater Britain.—II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

MAY 11.—"The Manufactures of Greater Britain.—III. India." By HENRY JOHN TOZER, M.A.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR LALIQUE (Paris). ARTHUR LASENBY LIBERTY, J.P., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Four Lectures.

LECTURE III.—FEBRUARY 27.—*Examples of Internal Combustion Engines in Britain.*—Coal gas and producer gas engines, Crossley, National, Stockport—Blast furnace gas engines, Cockerill, Oechelhauser, Koerting, Crossley, National—Petrol engines, Wolsley, Liddeley, Daimler—Heavy oil engines, Deisel, Hornsby, National, Crossley.

LECTURE IV.—MARCH 6.—*Future Developments*—Suction producers—Blast furnace gas—Producer gas in power-stations—Marine gas and oil engines—Line of advance.

HERBERT LAWS WEBB, "Telephony." Four Lectures.

LECTURE I.—MARCH 13.—*Telephone Instruments.*—The telephone industry—The Bell tele-

phone—Telephone receivers—Telephone transmitters—Evolution of the modern transmitter—Design of transmitters and receivers—Signalling appliances—Complete telephone instruments—Protective appliances—Special forms of telephones—Special uses of the telephone.

LECTURE II.—MARCH 20.—*Telephone Lines.*—Characteristics of telephone current—Necessity for metallic circuits—Overhead lines—Types of telephone line construction—Telephone cables—Evolution of special type of cable for telephone work—Conduits—Distribution—Aerial cables—Means of increasing range of transmission—Long distance telephony.

LECTURE III.—MARCH 27.—*Telephone Exchanges.*—Requirements of a telephone exchange—Early types of switchboard—Evolution of multiple switchboard—Switchboard signals—Automatic signals—Various types of exchanges—Various methods of operating—Common battery exchanges—Distribution of wires—Power plant—Telephone buildings—Automatic exchanges—Conduct of telephone traffic.

LECTURE IV.—APRIL 3.—*Development and Tariffs.*—Supremacy of telephonic communication—Essential features of modern telephone service—Organisation of telephone plant and business—Evolution of telephone rates—Scientific telephone tariff—Effect of area on cost—Varying demands of consumers—Graded classes of service—Telephone development in different countries—Long distance service and rates.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Dugald Clerk, "Internal Combustion Engines." (Lecture III.)

Farmers' Club, Whitehall-court, S.W., 4 p.m. Mr. Anker Simmons, "The Heavy Pressure of Taxation on the Agricultural Interest."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Harold Griffin, "Some Proposals for Improving the Law and Practice of Rating Property."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, FEB. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. C. F. Just, "The Manufactures of Greater Britain—I. Canada."

National Service League, Caxton-hall, Westminster, S.W., 5½ p.m. Admiral Sir Edmund Fremantle and Major Raymond Smythies, "The Naval and Military Advantages of Universal Naval and Military Training."

Colonial, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. Hubert Reade, "English Schools and Colonial Education: How can they be linked."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Karl Pearson, "Some Recent Biometric Studies." (Lecture I.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Richard William Allen, "Surface-Condensing Plants, and the Value of the Vacuum Produced."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, S.W., 3 p.m. Hon. J. H. Turner, "Fruit Growing in British Columbia."

WEDNESDAY, MARCH 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Isidore Spielmann, "The British Art Section of the St. Louis Exhibition."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, MARCH 2...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Rev. T. R. R. Stebbing, "Zoological Nomenclature. International Rules and others." 2. Dr. G. Herbert Fowler, "Biscayan Plankton. Part IV. The Thaliacea."

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. J. Campbell Brown, "The Latent Heat of Evaporation of Benzene and some other Compounds." 2. Messrs. F. B. Power and F. Tutin, "The Relation between Natural and Synthetic Glycerylphosphoric Acids." 3. Messrs. W. H. Perkin, jun., and S. S. Pickles, "The Reduction of Isophthalic Acid." 4. Mr. A. W. Stewart, "The Transmutation of Geometrical Isomers."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. H. H. Turner, "Recent Astronomical Progress." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Donald Murray's paper, "Type Setting by Telegraph."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. James F. Reade, "Engineering Expert Evidence."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 3...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting 9 p.m. Chevalier G. Marconi, "Recent Advances in Wireless Telegraphy."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Plaster Moulding and Casting."

Hospitals Association, Charing cross Hospital, W.C., 8 p.m. Mr. Donald J. Mackintosh, "The Control of Hospital Expenditure with Efficiency."

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

SATURDAY, MARCH 4...Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. G. Hogarth, "Archæology" (Lecture II.)

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FRIDAY, MARCH 3, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 6, 8 p.m. (Cantor Lecture.) DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Lecture IV.

WEDNESDAY, MARCH 8, 8 p.m. (Ordinary Meeting.) BARON SUYEMATSU, "Ethics of Japanese Society."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, February 27th, Mr. DUGALD CLERK, M.Inst.C.E., delivered the third lecture of his course on "Internal Combustion Engines."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, February 28th; the Right Hon. VISCOUNT RIDLEY in the chair.

The paper read was "The Manufactures of Greater Britain.—I. Canada," by C. F. JUST, Canadian Government Service in London.

The paper and report of the discussion will be published in a future number of the *Journal*.

CANTOR LECTURES ON MUSICAL WIND INSTRUMENTS.

Mr. D. J. BLAIKLEY'S Cantor Lectures on "Musical Wind Instruments" have been reprinted from the *Journal*, and the pamphlet (price One Shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor Lectures, which have been published separately, and are still on sale, can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, February 16th; SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., in the chair.

The CHAIRMAN regretted the cause of his presiding on this occasion, namely, the enforced absence of Lord George Hamilton.

The paper read was—

THE INDIAN CENSUS REPORT, 1901.

By SIR C. A. ELLIOTT, K.C.S.I., LL.D.

In drawing up this paper I have endeavoured to avoid coming into competition with the excellent paper read by Mr. Baines in March, 1903, and entitled "Gleanings from the Indian Census of 1901." He dealt mainly with the statistics then on record, for the report was not published till the middle of 1904. I have called my paper the "Indian Census Report," and in doing this I fear I have taken a rather presumptuous title, for the official report on the Census of 1901 is a vast compilation of statistics contained in three large quarto volumes, besides about 60 subsidiary volumes for the different provinces, and it is also a work of great erudition, enriched with information and speculation on many abstruse subjects connected with the ethnology and the religions and social customs of the people. It is idle to suppose that anyone could, in a short paper to be read before this Society, present anything like a complete sketch or review of so great an argument, and my effort will be simply to offer a few remarks, illustrating the most salient and interesting points, as a sample of the harvest to be gleaned by those who care to pursue the study of this important contribution to Anglo-Indian literature.

The Census of 1901 was carried out under the supervision of Mr. H. H. Risley, C.S.I., who has throughout his term of service shown a special interest in ethnological and social questions, and whose work on the "Tribes and Castes of Bengal," published in 1891, was a valuable addition to general knowledge. When he was promoted, in September, 1902, to the post of Home Secretary to the Government of India, the task of completing the report was handed over to Mr. Gait, who had distinguished himself in conducting the Census of Assam in 1891, and that of Bengal in 1901. Portions, however, of the present report, and especially parts of the chapters on religion, caste, and marriage, are Mr. Risley's own, and we owe the chapter on the 147 vernacular languages spoken in India to the accomplished pen of Dr. Grierson.

The Census of India has a static and also a dynamic side. The scientific man learns from it the actual facts concerning the population on a given date, while the administrator learns also the movement of the population, and the changes which have taken place during the past decade or series of years. The enumeration is a more elaborate business than it is in England or in any European country. It records not only the ordinary statistics as to number and density of inhabitants, age and sex, marriage and widowhood, and infirmities and occupations, but also as regards religion and the various sects into which the chief religions are split up, language and education, castes and the subdivisions of caste. In Mr. Risley's words (Report, p. 2)—

"It enables the rulers of India to take stock of their position, and to see how it has fared with the people committed to their charge. It fixes the statistical data on which all administrative action must be based. It tells the governing body what manner of men they have to deal with; how many will suffer from a failure of the rains, or will benefit by a well-conceived scheme of irrigation; what are the prospects of a new line of railway; what proportion of the population will be reached by a reduction of taxation; to what extent an overworked Government will be relieved by a transfer of jurisdiction, and what interests will be affected by the change."

The Indian Empire contains one and three-quarter millions of square miles, or more than the whole of Europe, excluding Russia. Within this area 294 millions of people were enumerated on the 1st March, 1901, of whom four-fifths were resident in British territory, and one-fifth in Native States. The mean density of the population was 167 per square mile, and it varied from 552 per square mile in the Delta of Bengal, to 150 in the Deccan, and 60 or 70 in Burma. There are many districts in Bengal and the United Provinces in which the density exceeds 500; some in which it approaches, and one in which it exceeds, 1,000 per square mile.

With such figures the spectre of over-population is ever present to the eyes of the Indian Government, and the first question for the solution of which we turn to the Census Report is: What is the rate of the increase? How fast is the flood mounting, and will a time come when it will overtop its barriers, and exceed the limits of food production? We have now had four censuses, more or less complete, in 1872, 1881, 1891, and 1901, and the answer given by the figures of this series is worthy of careful study. In 1872, the number counted was 205 millions, and it is now 294 millions; but we must not assume from this that there has been an increase of 89 millions in thirty years. The Census of 1872 did not include Kashmir or most of the Native States, and since that time Upper Burma, British Biluchistan, and several tracts on the borders of Assam and the Punjab have been added to British territory. Then again, there has been improved accuracy in the carrying out of every census, due both to the larger experience of the officials engaged in the work, and also to the gradual allaying of the fears and suspicions with which the operation was and still is to some extent regarded by large numbers of the people. After making these deductions, the recorded increase works out to the following figures:—

	Increase of Area. Millions.	Improvement of Method. Millions.	Real Increase of Popltn. Millions.	Total. Millions.
1872 81 ..	33	12	3	48
1881-91 ..	5½	2½	20	34
1891-1901	2½	—	4½	7
Total	41	14½	33½	89

The true growth of the population, after making allowances for the larger area of territory, and for greater accuracy in the enumeration, appears to be 33½ millions in 29 years, or 16 per cent.; not much more than ½ per cent. per annum. Such a result gives rise to a feeling of relief. It affords reason to hope that we are not drifting into certain disaster through the increase of popu-

lation up to a figure at which it would be impossible for the land to sustain them. On a survey of the entire conditions of the country, we may rest assured that there is sufficient room for expansion over the area still uncultivated, for improvement in the method of cultivation, and for the increase of artificial irrigation, to provide food and employment for a people increasing in number at this rate, if they will not exceed this rate, for many years to come.

But when we look closer into the causes which have controlled the rate of increase, we cannot feel the same satisfaction. In the period of 1872-81, there was a series of bad seasons, culminating in the great famine of 1876-8, and this kept down the growth of population to the small figure of 3 millions. The next decade was one of general agricultural prosperity, and was marked by no severe drought. As a result, the national increment was 26 millions, or nearly 10 per cent. In the last decade, the sufferings of the people from the two great famines of 1896-7 and 1899-1900 were very severe, and the effect of the mortality thus caused is shown in the small increase of 4½ millions. Had each of the three periods been as prosperous as the middle one, the population in 29 years would have grown, not by 34, but by 73 millions, and the danger of over-population and exhaustion of the soil would have been far more alarming. It is the business of the Government of India to cope with these seasonal calamities, and to draw their sting by measures of prevention and remedy. The more we are successful in doing this, the more urgent will the demand be for measures to increase the productive power of the soil, and to provide new occupations and new means of livelihood.

The total rise of 4½ millions in the population of the whole of India during the last decade is the resultant produced by combining together those areas in which there has been an actual decrease due to famine with those which have enjoyed fairly normal prosperity. The tract which suffered so grievously was about 600,oco square miles, or nearly a third of India, and comprised the whole of the Central Provinces, Central India, Rajputana and Baroda, the greater part of Berar, half of Bombay, two-fifths of the United Provinces, and a quarter of the Punjab. In this tract the population, which numbered 109 millions in 1891, fell to 98 millions, a loss of 11 millions, or over 10 per cent. On the other hand, in the rest of India there was an increase of 15 millions, or 8 per cent. The effect which a famine may produce in crushing out the vitality of a people could hardly be illustrated by more striking figures. It is not to be measured merely by the actual decrease. We must take into account what would have been the normal increase. The 109 millions in the area afflicted by famine would have risen, at the rate which prevailed in the rest of India, to 117 millions. They actually fell to 98 millions, so that to the direct and indirect effects of the two famines must be set down a loss of population amounting to 19 millions.

Perhaps a short account of the famine experiences of two or three provinces will enable you to realise the facts better than the statistics of the whole of India. In the small province of Berar, the number fell from nearly 3 millions to 2¾ millions, a decrease of 143,coo, or 5 per cent. But the vital statistics of previous years justified the expectation that the figure would have been higher by 297,000, so that mnst be considered as the real amount of loss by famine; for not only did the death-rate rise, but the birth-rate fell off materially. The children under ten years of age were in 1901 fewer by 150,000 than they had been ten years before, and the adults over fifty were fewer by 60,000. Between the ages of ten and fifty there was no such large decrease The report says:—

"Excessive mortality among the young, and a high, though less stiking, death-rate among the old, are the inevitable consequences of famine on a large scale."

And yet this great mortality occurred in spite of the most energetic efforts to assist the sufferers. The daily average number of persons relieved in 1899-09 was 265,742, or 9·2 per cent. of the population, and in July 1900 the figures rose to 601,424, or nearly 21 per cent.

The part of India which is the most salient instance of what the effects of famine on the population can be is the Central Provinces, which record not only a heavy actual loss, but also the highest proportional loss of all the administrative units in India. The Census of 1901 records a diminution of 1,071,000 souls, or 8·3 per cent., as compared with that of 1891. The registered death-rate, which had averaged 32 per mille in past years, rose during the famine years to 56 and 69 per mille, while the birth-rate dropped from a mean of 40 to 27 and 30 per mille. In the one good season of 1899 it rose again to 47, and

then in the second failure of 1900 it fell to 32 once more. The Census Report tells us that here, as elsewhere, the chief mortality was among the youngest and the oldest sections of society.

"There can be no question that in 1899-1900 the administration of the Central Provinces was signally successful in keeping alive the large section of the population whose only want was a sufficiency of ordinary food. Children at the breast alone could not be saved; their needs were and always will be of too special and delicate a character to be met by the rough machinery of famine relief."

Bombay is the province which stands highest in respect of the actual decrease of its population. Between 1891 and 1901 it lost a million and a half, or 5 per cent. of its numbers—a startling contrast to the results of the preceding census, which showed an increase of 15 per cent. during the decade. These melancholy figures are the result, not of famine only, but also of plague, which appeared first in Bombay city in 1896, and gradually spread over all the province, causing a heavy mortality, which probably approximates to half a million. But the main cause of the fall in the census numbers was the occurrence of the two famines in 1897 and 1900. During eight years out of the ten, the vital statistics showed an excess of 692,000 births over deaths, but in the years 1897 and 1900 the registered deaths exceeded the births by 92,300. In three of the Gujarat districts the death-rate rose to the enormous rate of 180 to 200 per mille, while the birth-rate fell to less than half the average of the decade. In one district the recorded deaths in 1900 numbered 88,000, or considerably more than in the nine preceding years taken together, and very nearly a third of the population enumerated in 1891.

A part of this mortality was no doubt due to the extensive immigration of famine refugees from neighbouring Native States, who came across the borders in a state of extreme destitution to seek relief in British territory. The chief of these States is Baroda, the conditions of which correspond closely with those of Gujarat. Baroda had enjoyed complete prosperity up to 1899, and the shocking depopulation which has taken place is due entirely to the ravages of that year. The population, which had been counted as 2,415,000 in 1891, fell to 1,952,000 in 1901, a loss of 463,000, or 19 per cent. Greater efforts were made by the official staff of the State to relieve famine than had ever been made before, probably, in any Native State, and yet the results were wholly insufficient.

These statistics show that the mortality resulting from the two famines was more terrible than even the two special commissions which reported on them realised, but they afford no ground for censure of the efforts made to relieve distress, or for crying out against the inevitable. The Census Report is careful to point out that only a small portion of the deaths which occur during a famine is due to actual starvation. A great part is caused by epidemics of cholera occasioned by the collection of a large number of persons in relief works, and the pollution of the scanty water supply. No help can be effectually given to people who refuse to apply for it, and who conceal their wants. Those who know most about the relief measures adopted in India are also those who most admire the energy, the self-devotion, and the zeal of those engaged in the struggle, whether officials or non-officials, whether of the white or coloured races. It cannot be claimed that finality has been reached in these measures. New experience is gained in each famine, and new administrative improvements are introduced. The two great preventive remedies, diversity of occupations and extension of irrigation, must not be lost sight of, and I welcome the recent announcement that the Government of India has sanctioned the construction of a connected scheme of three new great canals in the Punjab which will irrigate about two million acres at the low cost of Rs.40 per acre. But the main conclusion left in the mind by a study of this part of the Census Report is identical with that which has so deeply fashioned the whole train of Hindu thought, the impotence of man before the destructive powers of the elements.

Besides the statistics which I have quoted as to the actual decrease of the population in some parts of India and the check to the natural increase in others, the effects of famine are felt in many ways, and have sunk deep into the social life and condition of the country. I have already referred to the age statistics, which indicate a considerable falling off in the number of children below ten, and a lesser decrease in the number above sixty, these two being the classes among which the pressure of scarcity was most severely felt. In the religious statistics again we find a slight proportional decrease among Hindus and increase among Mohammedans, the explanation

of which is not that there has been any proselytising activity among the Mohammedans, but that the tracts mainly inhabited by them, especially Lower Bengal, Sind, and the Upper Punjab, were not visited by famine, while the area where it was most severe was the stronghold of Hinduism.

The sex statistics tell a similar tale. The proportion of the sexes has always been a perplexing question in India, inasmuch as while in all European countries females outnumber males, in India the reverse is the case, and the recent census shows that there are only on an average 963 females to 1,000 males. The fact that the disproportion varies greatly in different parts adds to the perplexity of the case. In the Central Provinces and Madras the females are in excess, the enumeration showing 1,031 and 1,025 females respectively to 1,000 males; in Bengal the numbers are almost equal; on the other hand, in Kashmir and the Punjab they fall below 900 females to 1,000 males.

But while the average number of women to 1,000 males was 963 in 1901, it was only 958 in 1891, an increase of five women to every thousand men. This relative increase in the number of women during the last decade appears to be closely connected with the prevalence of scarcity and famine. In the parts of Bengal where there was a good deal of scarcity, Bihar and Chota Nagpur, the ratio of women to men has risen. In the Central Provinces, where there was the greatest pressure of famine, the relative increase of the female sex has been greatest of all, and in the United Provinces, Bombay, Baroda and Rajputana, all of which suffered severely, the same result is very noticeable. All the authorities seem agreed in holding that women succumb to famine less easily than men; and the diminution of the birth-rate, with the lessened risk of life from parturition, also tends in the same direction.

A further instance of the working of the same far-reaching cause is to be found in the enumeration of the sufferers from four classes of infirmity—the insane, deaf, blind, and lepers.

	1891.	1901.
Insane	74,279	66,205
Deaf	196,861	153,168
Blind	458,868	354,104
Leper	126,244	97,340
Total	856,252	670,817

Other causes have no doubt co-operated in producing this reduction, such as greater accuracy of diagnosis, improved sanitation, and the larger amount of relief procurable in hospitals and dispensaries. In the case of the blind, too, a special cause has been at work; for there is no operation performed by English surgeons in which the people of India have greater confidence than the operation for cataract. They flock to our hospitals to obtain this relief, and during the last ten years 146,000 persons have by its means recovered their sight. But, putting this aside, the main and most general cause of the diminution in the numbers of those afflicted with these infirmities was undoubtedly the famines, which fell with especial severity on those who generally live by begging, and who are less capable of succeeding in the struggle for life than the mass of the population. The insane and the leper are the two classes which would naturally suffer most; the insanes because they are seldom able to apply for help, and the lepers because they are almost always outcasts possessed of no stores or resources.

Leprosy is a disease which specially arrests attention, on account of its loathsome character and its former prevalence in Europe, and the Report records a decrease in its figures from 56 per 100,000 in 1881 to 33 now. The Leprosy Commission of 1890 reported that the disease is not due to hereditary transmission or to contagion, but originates *de novo* in each case, and that it cannot be connected with any geological conditions nor to temperature or climate, nor yet to any class of food. Nothing has since transpired to increase our knowledge of the question, nor do the census statistics throw any fresh light on the subject. All that they do is to enable us to prepare maps illustrating the areas where the disease is most prevalent, but these areas seem to have nothing in common. In certain districts in West Bengal, centering in Bankura, it is twice as prevalent as in any other part of India; then comes the Goalpara District of Assam, then West Berar, then a tract along the southern face of the Himalayas. The physical and climatic characteristics of these tracts differ as widely as do the races who inhabit them and their food supply. No bacillus causing or associated with leprosy has yet been fouud. The old hypothesis that it may be connected with eating imperfectly cured fish, recently revived by Mr. Jonathan Hutchinson, finds no support in the census statistics. Where science has discovered so much, there is no reason to despair of ultimate success in laying bare the causation of this horrible disease,

and we may hope that the historian of the next census will have some new light to throw on it.

The last instance I have to give of the influence of the famine on the movement of the population, though in this case the influence is more distant and indirect, is the progress of Christianity. The number of Christian natives in India, which was 1¼ millions in 1872, is now 2⅞ millions. Of these two-thirds, or about 1,700,000 are Roman Catholic or Syrians, mostly descendants of the converts made some three centuries ago by St. Xavier and others in Southern India. The Protestant or Reformed Churches number about 850,000, or one-third of the whole, and they are mostly the product of missionary enterprise during the latter half of the last century. During the last decade they have increased over the whole of India by 75 per cent., but in several provinces the progress has been even more striking. Their numbers have trebled in the United Provinces and Central Provinces, and they have doubled, or more than doubled, in the Punjab and Assam.

The Census Report deals with admirable fairness and sympathy with this question of the evangelisation of India. The influences which combine to favour the spread of Christianity are discussed, and it is admitted that the motives for conversion are not always wholly spiritual, but it is shown that the charge that many change their religion merely from hopes of material gain is refuted by the mere largeness of the numbers, as it would be impossible for the missionary bodies with their scanty resources to contribute materially towards the support of many converts. That conversions are most frequent among the lower castes of Hindus is easily explained by the fact that among them philosophic doubts and social disabilities have not much weight, and by the advancement in education and social position which Christianity offers. In the case of the aboriginal tribes of Chota Nagpur the movement toward Christianity has been largely influenced by practical considerations. "They look to missionaries for help in their disputes with their landlords, and they see in Christianity a means of escape from the payment of fines imposed on witches and on those who are supposed to have neglected the demons, and from the persecution to which they would be subjected if unwilling to meet the demands of the *Bhuts* (spirits) and their earthly servants." In many provinces the results of famine have been to fill orphanages with waifs and deserted children, who are brought up as Christians. Thus in the Central Provinces the number of converts belonging to Protestant Missions has risen, since 1891, from 1,000 to 10,000; in Bombay from 5,000 to 33,000; and in Baroda, where there were only 41 converts in 1891, there are now over 7,000.

A curious sidelight is thrown on the missionary question by comparing the number of natives who have been converted to Christianity with the number who have been taught English. I omit provinces like Madras in which Christianity has become hereditary, and taking only those in which the conversions date mainly from the last two generations, Assam, Bengal, United Provinces, Punjab, Bombay, I find that the census records 727,000 people as English literates. Unfortunately it did not distinguish the English and Europeans who learn English instinctively, at home, as a mother tongue, from the natives who learn it educationally, at school, as a foreign language; but the previous census did make this distinction, and the number of natives was then found to be three-quarters of the whole. Assuming the same proportion to exist now, the number of English literates among the native population of the provinces I have named is 550,000. The number of native Christians in the same provinces is 487,000, which is not much less. When we consider the nature of the influences engaged in either case—on the one hand, the zeal of the missionaries, isolated individuals for the most part, with no official position, and very exiguous funds; on the other hand, the efforts of the education officers, with large supplies of money and the prestige of Government behind them; on the one hand, the sacrifice of family ties and old associations which conversion entails, on the other hand, the prospect of Government service or at least of well-paid and comfortable employment which an English education promises—it is wonderful to find that the successes of the Gospel come so close, numerically, to those of the Government department.

Before leaving this branch of my subject, I cannot refrain from quoting an interesting passage in Mr. Rose's report on the Punjab census, which gives an account of a sect called the Chet Ramis, after one Chet Ram, who died about thirty-five years ago. He was a man of little education, the son of a moneylender in the Lahore district, and he began his mission when about twenty-five years of age. The chief basis of his teaching was implicit confi-

dence in Christ as the only God. A copy of the Bible was to be worn by each of his disciples round his neck, and they were to carry a long rod with a cross at its head, with the following inscription:—"Help, O Jesus Christ, Holy Ghost, God. Read the Bible and the Gospels for salvation." The sect has largely increased in numbers since the census of 1891, when it was little known, and was supposed to be purely atheistic. This story is remarkable as one of many proofs that the doctrines of Christianity have sunk deeper into the conscience of the people of India than the mere numbers of conversions indicate.

I turn now from those parts of the Census Report which deal with the movement of the population—the dynamic portion—to those which depict its actual condition—the static part—but I have only time to touch, and that too briefly, on the three chapters on language, marriage, and caste. These are the most valuable part of the report from the scientific point of view, and they are written by the two men who are the greatest living experts on these subjects—Dr. Grierson and Mr. Risley. Dr. Grierson has for the last eight or nine years been employed by the Government of India on a linguistic survey, or exploration, of the languages spoken in the northern and central parts of India, and his task is, I believe, nearly finished. He divides the 147 vernacular tongues enumerated in the census into three main families—the Dravidian, spoken by the aboriginal population; the Indo-Chinese, spoken by invaders from the N.E.; and the Indo-European by invaders from the N.W. The complexity and elaborateness of many of the Dravidian and Indo-Chinese tongues is hardly conceivable. For instance, in the Santhali language, the conjugation of the verb "to strike" occupies 100 pages of Mr. Skrefrud's grammar. In some languages the verb has no passive voice, only an affirmative and negative voice. No Tibeto-Burman language has a verb at all; for "I go" they say "my going." In some cases we find agglutinative tongues beginning to isolate their monosyllables—in some, phonetic attrition is turning dissyllables into monosyllables, and so the process of endless change continues. Dr. Grierson writes:—

There are languages whose phonetic rules prohibit the existence of more than a few hundred words, which cannot express what to us are the commonest and most simple ideas; and there are others with opulent vocabularies, rivalling English in their copiousness and in their accuracy of idea-connotation. There are languages, every word of which must be a monosyllable, and others in which syllable is piled on syllable till the word is almost a sentence by itself. There are languages which know neither noun nor verb, and whose only grammatical feature is syntax, and others with grammatical systems as complicated as those of Greek and Latin. . . . There are parts of India which recall the plain in the land of Shinar, where the tower of old was built, and in which almost each of the many mountains has its own language, and there are great plains, tens of thousands of miles in area, over which one language is spoken from end to end.

The main group of languages, spoken by 221 millions of India belongs to the Indo-European family. The origin of the races which compose this family has been placed in various localities; first the mountains of the Caucasus or the Hindu-Kush, then in North-Western Europe on the shores of the Baltic, then in Armenia and Northern Persia; and, lastly, Dr. Grierson seems disposed to agree in the view which locates their domicile on the borderland of Asia and Europe, the steppe-country of Southern Russia. Here, he tells us, they broke into two divisions. The first, who, in speaking of the number 100, used a word similar to the Latin word *centum*, turned westwards and became the parents of the Greek, Latin, Keltic and Teutonic races. The second, who described the same numeral by the Sanscrit word *sat*, wandered to the East, and from their speech descended the languages known as Aryan, Armenian, Phrygian and others. It is with the Aryan sub-family of the Indo-European family that we are concerned at present. Leaving the common home, they probably took their way north of the Caspian and settled in the oasis of Khiva for a time; and then dividing again, one branch went westward to Merv and Persia, one crossed the Hindu-Kush and entered India by way of Cabul, and settled in the Punjab. But this settlement did not take place all at once, but gradually, and Dr. Grierson holds that that there was a distinct and important later invasion which penetrated like a wedge into the country already occupied by the first immigrants, forcing them outward and backward in the north, south, and west directions, and pressing on itself into the "middle land" of Aryan tradition, the Valley of the Ganges and Jumna.

We have all been brought up to believe in this doctrine of the Aryan invasion from the North-West, and we have often, no doubt, found it hard to realise how such

an immigration was carried across deserts and mountains which even a Russian army with railways and transport organisation would find it hard to traverse; especially if we are to believe they did succeed in bringing their women with them, so as not to be reduced to the necessity of capturing Dravidian brides. Mr. Risley's solution of these questions is an ingenious one. He produces evidence from history and physical geography that the desert plains of South-Eastern Persia and the dreary steppes of Central Asia were once a fertile, populous and well-cultivated tract; but in process of time the climate changed, the forests were cut down, rainfall diminished, the level alluvial tracts lapsed into desert, and the population, as they began to press on their own means of subsistence, or were pushed forward by incursions from the West, moved by tribes or families as an organised society and occupied the valley of the Indus. This movement must have lasted over many centuries, and when the process was completed and the country behind was turned into a waterless desert, haunted by robbers, later invaders could only enter by force of arms, bringing hardly any women with them. Then the second Aryan invasion, traced by Dr. Grierson's linguistic researches, pushed on through the country occupied by the first Indo-Aryans into the valley of the Ganges and Jumna, where they came in contact with the Dravidians and produced the Aryo-Dravidian race which is now established there. "Here from the stress of this contact, caste was evolved; here the Vedas was composed, and the whole fantastic structure of orthodox ritual and usage was built up."

Mr. Risley's researches into the origin and characteristics of caste have been largely helped by the ethnographic survey which he started tentatively in 1890, and which is now being carried out on a comprehensive scheme under Lord Curzon's order. The measurements taken are those of the length and breadth of the skull, the height and breadth of the nose, and the stature, these being accepted as the most persistent indications of difference in blood and race. India, with its strict rules as to marriage, is a peculiarly favourable field for this method of investigation. In a society putting an extravagant value on pride of blood and the idea of ceremonial purity, difference of physical type, however produced in the first instance, may be expected to manifest a high degree of persistence. Mr. Risley tells us that the longest heads, the tallest stature, and the highest noses, are found in the Punjab, and there is a progressive decline in height and increase in breadth of head and nose down the valley of the Ganges to Bengal, and to the south.

He adds that the relations of the nasal index to the social position of the caste are remarkable. If we take a series of castes in Bengal, Bihar, the United Provinces of Agra and Oudh, or Madras, and arrange them in the order of the average nasal index, so that the caste with the finest nose shall be at the top, and that with the coarsest at the bottom of the list, it will be found that this order substantially corresponds with the accepted order of social precedence.

When the census officer attempts to lay down a scheme for the classification and enumeration of castes, he is met by great and unexpected difficulties. Mr. Risley defines caste as a collection of families bearing a common name which is usually associated with a specific occupation, claiming common descent from a mythical ancestor, and forming a single homogeneous community. No member of a caste can marry outside his caste; and it usually contains a number of smaller circles within which marriage is confined. It is the marriage law which forms the essential distinction of caste; the rules regarding food and drink naturally come first to the notice of the superficial observer, and have been held to be the special peculiarity of caste-observance; but they are comparatively fluid and transitory, whereas the marriage-regulations are permanent.

But while this definition of caste seems to confer on it an iron-bound, immutable character, it is, in fact, an institution in a state of continual flux and variation, subject to the influences of rise and fall of social condition and subdivision of occupation. Tribes have been and are still being converted into castes; changes of occupation bring about the formation of separate sub-castes; religious sects when they become numerous re-organise themselves on the lines of a regular caste, and create for themselves rules for the restriction of marriage limits; new castes are formed from the offspring of irregular sexual relations, and from the migration of a party from the headquarters of their caste to a distant place, which subjects them to the suspicion of having departed from the original strictness of regulations, and tends

to break the *jus connubii*, and so separates them from the parent stock. Many interesting and curious examples are given in the report of these processes which are constantly going on under the eyes of our Indian administrators, but space will only allow of quoting one of them. Referring to the way in which aboriginal tribes, having risen in the world and become landed proprietors, get themselves enrolled, by some mythical assumption, generally connected with a miracle, in one of the more distinguished castes, Mr. Risley writes:—

"The most picturesque instance of the class of legend to which I refer is that associated with the family of the Maharajas of Chota Nagpur, who call themselves Nagbansi Rajputs, and on the strength of this mythical pedigree have succeeded in obtaining wives of reputed Rajput blood. The story itself is a variant of the well-known Lohengrin legend. It tells how a king of the Nagas, or Snakes — the strange prehistoric race which figures so largely in Indian mythology—took upon himself human form and married a beautiful Brahman girl of Benares. His incarnation, however, was in two respects incomplete, for he could not get rid of his forked tongue and evil-smelling breath. In order to conceal these disagreeable peculiarities he always slept with his back to his wife. His precautions, however, were unsuccessful, for she discovered what he sought to conceal, and her curiosity was greatly inflamed. But the Snake King, being bound by the same conditions as his Teutonic prototype, could only disclose his origin at the cost of separation from his wife. Accordingly, he diverted her attention by proposing to take her on a pilgrimage to Juggurnath. Their route lay through Chota Nagpur, and when they reached the neighbourhood of Ranchi the wife was seized with the pains of child-birth, her curiosity revived, and she began to ask questions. By folk-lore etiquette questions asked at such a time must be answered, and her husband was compelled to explain that he was really the Takshak, King of the Snakes. Having disclosed the fatal secret, he straightway turned into a gigantic cobra, whereupon his wife was delivered of a male child and died. The poor snake made the best of the trying position in which he found himself; he spread his hood and sheltered the infant from the rays of the midday sun. While he was thus occupied some wood-cutters of the Munda tribe appeared on the scene and decided that a child discovered in such remarkable circumstances must be destined to a great future and deserved to be recognised as the Raja of the tribe. This is the family legend of the Nagbansi (or snake-child) Rajas of Chota Nagpur."

This description of the fluid and fissiparous character of the institution explains the difficulty of establishing any sound classification of castes. As Mr. Risley observes, in a country where the accident of birth determines the whole course of a man's social and domestic relations, and he must eat, drink, dress, and marry in accordance with the usages of the community into which he is born, one would suppose that the question to what caste he belongs is one which he would answer with certainty and precision. If he belongs to a well-known tribe or caste this is the case, but if he belongs to an obscure, isolated, or newly-formed caste he may give the name of a sect, a sub-caste, an exogamous sept, or may describe himself by his occupation or the tract of country from which he comes. To reconcile all these various titles and to co-ordinate them under the head to which they really belong, is impossible. The principle adopted in the recent census was to accept the names as given and to classify them according to their social precedence as established by the facts:—

"That Brahmans of high-standing will take water from certain castes, or will serve certain castes; that some castes, though not served by the best Brahmans have got Brahmans of their own; that some are not served by Brahmans at all, but have priests of their own; that the status of some castes has been raised by their taking to infant marriage, or abandoning the re-marriage of widows . . . . that some can claim the services of the village barber and some cannot; that some may not enter the courtyard of certain temples, or must not use the village well, or may draw water only with their own vessels, or must live outside the village or in a separate quarter, or must leave the road on the approach of a high caste man, or must call out to give warning of their approach."

The classification, made on this principle, was drawn up in each province in consultation with its own experts and representative men, and the names and numbers of the different castes in each province, arranged in from four to seven or eight classes, will be found in the Report by those who wish to study the subject more deeply.

The last subject on which I can touch to day is that of marriage, and there are few things more curious than the laws which govern marriage in India and the anomalies which some of these produce. It is generally known that the rules about prohibited degrees are strict: there are classes into which a man must marry and sub-classes into which he must not marry. Every Brahman must marry a Brahman, every Rajpoot a Rajpoot, and so on; but there are ten main subdivisions of Brahmans and thirty-six royal clans of Rajpoots, and no one may marry into his own subdivision

or clan. These rules seem on the whole to have sprung from wise experience; they secure community of blood and manners, while they avoid the danger of close breeding in and in.

But there is another law to which Mr. Risley claims to be the first to draw the attention of ethnologists, and which he calls the law of hypergamy. You must marry your daughter to a clan or subdivision above you; for your son you may take a daughter from a clan below you. This often leads to difficulties. Suppose the Rajpoot clans to be arranged in order of precedence from A to Z. Then it is easy to for B to give his daughter to A and to take a daughter for his son from C. But what are A and Z to do, with no one above them or below them? The custom of female infanticide among the higher classes sprang largely from this difficulty, as they would not acknowledge any clan higher than themselves.

Readers of Tod's "Rajasthan" will remember the romantic story of the Princess of Udaipur who was wooed by her only two possible suitors, Princes of Jaipur and Jodhpur, and how to save those two great clans from a destructive war she nobly devoted herself to death. A more modern effect of the same system is the custom known in Bengal as Kulinism, under which a single Brahman of very high rank marries 50 or 100 girls of a sub-caste just inferior to his own—a custom which one is glad to see the Census Report declares to be dying out.

What was the origin of this curious practice? No explanation is given of it in any vernacular works, and Mr. Risley declares that it has escaped the notice of all modern writers on the early history of marriage. The only suggestion that he can make is that it may have risen from the invasion of a conquering race who might naturally take wives or concubines from among the conquered, though they would not give their daughters to them. From this origin it might "extend itself by the operation of imitative fixtures to the connubial relations of all classes not absolutely equal in rank."

This explanation is simplicity itself compared with the difficulty of accounting for another custom, that of infant marriage, which, according to Mr. Risley, is steadily increasing, and has almost displaced adult marriage among the higher castes, insomuch that in 1901 16 per cent. of the female population or 2,000,000 girls were found to be married and below the age of ten. What, he asks, induced people already practising a rational system of adult marriage to abandon it in favour of a rigid and complicated system of infant marriage? Among lower castes it has been consciously borrowed from the higher castes by that tendency to imitation which we may almost describe as an ultimate law of the caste system. But how did the higher castes come by a custom which is without parallel, at any rate on so large a scale, elsewhere in the world, and which cannot be referred to any of those primitive instincts which have usually determined the relations of the sexes? Neither sexual passion nor the desire for companionship and service can account for a man marrying a girl when she is physically incapable of fulfilling any of the duties of a wife.

The prohibition of widow re-marriage is not so widely spread as the custom of infant marriage, and its possible origins are not so hard to find, but still it offends against natural instincts, and where the number of the female sex falls short of the males, it must create great inconvenience. Several causes are alleged in explanation, though none are fully satisfactory, and one which sets out that among the higher castes the difficulty of finding husbands for their girls is great, and would be greater if widows could compete, is a sentiment which, as Mr. Risley remarks, smacks strongly of the philosophy of Mr. Weller, senior. As long as this is the attitude of the higher castes, the lower castes will be more and more drawn to follow it, through the strong tendency to imitation. The Hindu mind has a passion for ceremonial purity, and takes a pleasure in giving up practices it delights in, if they are opposed to the ascetic rule and to the practice of Brahminical caste. Mr. Risley acutely remarks that, contrary to general expectation, the strength of the Hinduising movement has been greatly augmented by the improvement of communications. "Railways, which are sometimes represented as a solvent of caste prejudices, have enormously extended the area within which caste prejudices reign supreme." It is to be feared that the efforts of the few leaders of native society who are affected by English thought and standards will have a harder struggle than ever against the spread of prohibitions which have such a strange attraction for the people of India.

I should have liked to have added a few remarks on some of Mr. Risley's interesting speculations on the origins of religious ideas, based on his unrivalled knowledge of the pro-

cess of thought in aboriginal minds, but time does not permit, and I must close a paper which is I fear already too long.

Lord Curzon, in his speech on July 20th, last year, at the Mansion House, paid a tribute to the great administrative ability of the members of the Indian Civil Service, whom he described as the "organisers of victory." This Census Report is in a high degree evidence of these qualities. I have written in vain if this audience have failed to appreciate the organising talent shown in the planning of the census operations, the administrative ability which trained and disciplined the vast body of men employed in carrying them out, and the literary and scientific power shown in marshalling these results and drawing out the conclusions to be deduced from them. I have only gleaned a little from the fair crops of administrative wisdom, religious legend, ethnic myth, and philosophic speculation to be found in the report, but I trust I have said enough to show the immense field it covers, and the sterling value of the contributions made to our knowledge of India by Mr. Risley, Dr. Grierson, and Mr. Gait.

DISCUSSION.

Mr. J. A. BAINES, C.S.I., said that if there had been any material difference between his views on the subjects dealt with and those of the author he would be diffident in expressing it since he had the most agreeable and grateful remembrance of the way in which his tottering footsteps in census-taking were guided by Sir Charles Elliott, to whom, as first Census Commissioner, much of the success of the operations had been due. Each census was more accurate than its predecessor, but the foundations had been laid soundly at the outset. He could only deal with one or two of the many interesting points contained in the very comprehensive paper before them. In the first place, it was important to recognise, as the author had done, the two aspects in which the census should be regarded. The complications of Indian civilisation entailed a knowledge of the statical side, though he was of opinion that ethnology might be better treated by an expert once for all, and his work given as a reference by census reporters, and thus save the introduction of much discussion of "origins." As he had been himself a sinner in this respect, he would say how grateful he was for the confirmation in 1901 of views he had put forth tentatively ten years before, as to the routes and succession of the Aryan occupation of Upper India. On this, the evidence of Dr. Grierson, was, he thought, conclusive. Again, he welcomed the importance given to the desiccation of the regions bordering India to the north-west in the ethnology of that country, since, by this process, the Aryans had been cut off (in course of time) from their racial base, and left to develop their civilisation on independent and unique lines. In the dynamic aspect of the census he was inclined to include the movements of language and religion. The former, as admirably analysed by Dr. Grierson, tended to restrict the linguistic differences amongst the hill tribes, whilst the actual population was increasing. Much the same might be said of the tribal forms of religion, under Brahmanic pressure. He would call attention, in connection with this matter, to the difference in its social results of a change to one of the non-Indian religions, such as Christianity or Islam, from absorption of tribes into the Brahmanic fold, or change of sectarian doctrine inside that sphere. The latter kept the convert as he was in social position, provided only doctrine was touched, and sects of this sort were, therefore, largely recruited from the upper classes. But modification of ceremonial or social rank involved the creation of a separate community, and was favoured, accordingly mostly, if not solely, by those who had little position in society to lose or gain by the change. In conclusion, he expressed the great pleasure he felt in finding that the first Census Commissioner for India had so long retained his interest in that important subject.

Dr. G. GRIERSON, C.I.E., said he only wished to refer to the use, in the Census Report, of the word "Dravidian." When the linguistic chapter of the census was written the Linguistic Survey of India had not reached the Dravidian languages, and what was written then was written on the knowledge that was generally held by people in those days. Since then things had considerably altered. Owing to the progress made by the Linguistic Survey, the Dravidian languages had been analysed and examined, and some remarkable discoveries had been made. There were in India proper, roughly speaking, three families of languages—the Aryan in the north, the Munda in the hills of the centre, and the Dravidian in the south, and also in Baluchistan. When Mr. Risley made the most important discovery, during his ethnographical enquiries in Bengal, that the Mundas and the Dravidians had an identical ethnographic type, that was to say, they had the same nasal index and the same size of head, and so on, the fact was accepted as quite natural, because it was very generally thought that the Munda and the Dravidian languages, though very different at the present day, had a common origin; but he thought when the results of the Linguistic Survey regarding them were published no one would be able to deny that the origin of the Munda languages and the origin of the Dravidian languages must be taken as entirely separate. They were not the same, or had not been, at any rate, this side ot the Tower of Babel. They were different in phon-

ology, different in method of making up words, different in syntax, and different in every particular which is of importance for philological classification. Basing his nomenclature on the fact that both the tribes who spoke Munda languages and those who spoke Dravidian languages had the same physical type, Mr. Risley had called that type "Dravidian," and in the ethnographical portions of the Census Report the word was used in this extended sense. But the application of the name to two families of people speaking two distinct and very different languages, although having exactly the same physical characteristics, would give rise to confusion, because Mr. Risley's Dravidian physical type would, on the other hand, include many millions of people who did not speak the Linguistic Survey's Dravidian languages, while, on the other hand, the speakers of the Linguistic Survey's Dravidian languages would include the speakers of Brahmi in Baluchistan, who have not Mr. Risley's Dravidian type. He himself thought that what Mr. Risley called Dravidian should be called by some other name. It seemed an injudicious thing for a linguist to do, but he would like to make a suggestion as to how it was possible that the Dravidians of Southern India had the same ethnic type as the Mundas. He only gave it as a suggestion. They all knew how the Aryans, as they moved eastwards from the Punjab down the Ganges Valley, became more and more aboriginalised, and so in the east of Bengal there were now so-called Aryan tribes who had all the characteristics of the aborigines, flat noses, curly hair, and so on, and yet they had retained the Aryan language. That was the important point. The Aryans had retained their language, but altered their physical type. Why was not the same thing possible with the Dravidians? If they came in from the north-west, say through Baluchistan, and went down south, they would retain their language as the Aryans had done, and by mixing with the aboriginal Mundas they would naturally acquire the physical type of that ethnological family.

Mr. J. D. Rees, C.I.E., said they must all congratulate themselves on the fact that a gentleman of the author's position and ability had undertaken the task of popularising some of the results of the census which were buried in the Blue-books on the subject. Few people had undertaken the task—he had tried to do so in one of the Reviews—and it was most regrettable that a report that was so replete with interesting information should be practically closed to the British public. The author had referred to the condition of the poor, and the serious results of the last famine in decreasing the population. He thought some misunderstanding was likely to result if one looked only at the ordinary accounts of the famine, but that misunderstanding would soon be dissipated on a perusal of the Blue-book. There was a larger proportion of people in receipt of relief at the expense of the State in England in a normal year than there was in India during the height of the famine. The author had referred lightly to the question of leprosy in India. Mr. Hutchinson had been preaching that the prevalence of leprosy in India was due to the use of imperfectly cured fish; but the author pointed out that that was flatly contradicted by all the authorities who had been appointed on the subject. As to caste and the progress of Christianity, he thought it would be well to guard themselves against thinking that the large increase in actual numbers of Christians in India went to prove that caste and Hinduism were in anyway relaxing their hold upon the people. In fact, Mr. Risley himself pointed out in the Census Report that the railways, which had been spoken of as the breakers down of caste, practically led to its greater strength. He could confirm that himself from his experience as a director of the South Indian Railway. As soon as a railway was opened, the number of pilgrims to the great temples in the south enormously increased, and yet in that very room he had heard not long since a distinguished gentleman from India point out that caste was the curse of the people of India, and that it was, to his great joy, disappearing and diminishing in strength every day. They had in the Census Report an exact contradiction of that statement, upon the highest authority after the most careful and comprehensive examination.

Mr. F. H. Skrine said that he had listened to Sir Charles Elliott's story of the Indian Census with the deepest interest because, like many of his colleagues who were present, he had taken an active part in these decennial numberings of the people. In 1871 the authorities were confronted by a universal suspicion that the census was a prelude to some form of taxation. Thus the unhappy enumerators met with refusals and evasion on all sides; and many returns were evolved from their own inner consciousness. This attitude of the population at large served to explain the shortage of women in the returns. The disproportion between the sexes was, probably, no greater in India than elsewhere; but indulgence in polygamy was an outward and visible sign of wealth: and in the old Mughal days an appearance of wealth was sure to attract the attention of the tax-gatherer. The most important point made in the "dynamic" section of the paper was the light it cast on the working of Malthusian doctrines. It was clear that some, at least, of the checks on over-population enumerated by Malthus were coming into play; and that Government was powerless to protect the masses from the result of their ingrained improvidence, resting as it did on religious sanctions. Turning to the static portion of the paper, he agreed with Mr. Baines in thinking that excessive attention was given in the Census Reports to ethnological speculation. The origin and migrations of the human race were too complicated and obscure for treatment in official reports. It would baffle the eru-

dition of Dr. Grierson to explain why the Finns, Magyars, and Basques spoke an agglutinative tongue which had close affinities with the Dravidian languages of Southern India. He was at one with the author as to the vast influence of railways and steam navigation in developing the caste system and increasing religious sentiment. By enabling the poorest Indian to revive his flagging faith at the centres of pilgrimage, they had given new life to every creed. Taken as a whole, the paper was worthy of its subject, and that was saying a good deal. The evolution of the census, in the teeth of widespread apathy, ignorance, and suspicion, ranked foremost among the many triumphs of British administration in India.

Mr. MARTIN WOOD said he wished to make just one remark on what Mr. Baines had spoken of as the dynamics of the subject—the normal increase of the population, or abnormal shrinkage of its growth. This consideration was necessarily dealt with in the more serious passages of Sir Charles Elliott's valuable paper. For his part he thought that the chief means of preventing famine, or lessening its intensity, was to wage war against drought. There was not, as far as he could see, a single water-work erected in those districts which had suffered most—as mentioned in the paper, British Guzerat, Central Provinces, and the Deccan—whereas an enormous work had been designed and accepted in the east of the Punjab, a district which had not suffered much from the famine. He did not think it was right that local works which were most urgently required should be neglected.

Sir CHARLES ELLIOTT said he did not purpose at that late hour to enter into any of the questions raised in the discussion, except as to the criticism that too much had been said in the Census Report dealing with ethnology, origins of religions, &c. He thought there was a considerable amount of truth in that criticism, but he would point out that in ten years' time they might not have another Census Commissioner of the same gifts with regard to those topics as Mr. Risley. In the course of a census an officer was brought into close contact with those questions, and had time to go into them thoroughly; and if he had a strong natural turn for such subjects, it was practically impossible for him not to put them before the public in the shape of an official report.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author for his exceedingly interesting paper.

Mr. BAINES writes:—Having dwelt overlong on the ethnographic side of the paper, I was prevented from commenting upon the figures quoted. There is one point, however, which, in case it was not noticed by those who spoke after I left, I should like to mention, viz., the rate of growth of the population. For the reasons given by Sir Charles Elliott, the bare totals, even when qualified by the deductions he makes, are not accurate indications of the rate of increase under really normal conditions, *i.e.*, ten years without severe famine or a continued series of unusually favourable seasons. We have to trust, therefore, to the age returns, not in their crude form, but after actuarial treatment. It appears from these that a remarkably high birth-rate, due in great measure to the universality and early age of marriage, is greatly neutralised by a high death-rate, especially amongst infants, which, in India, as in most other countries of the Old World, is the usual accompaniment of great prolificity amongst the masses. We find, moreover, that life in India is considerably shorter than in temperate regions. Thus, the average rate of increase established by the comparison of the figures of the three enumerations comes out a little below 1 per cent. per annum. With the spread of medical aid and trained midwifery this may be slightly raised, but otherwise, in the conditions of Indian industry now subsisting, and likely to continue for some time to come, the above rate is probably as high as the country can support without an economic change for the worse; because the whole burden of the increase being practically borne by the soil, a larger share of the cultivated area would have to be directly devoted to the production of the means of subsistence, instead of, as now, providing an important reserve of raw, non-food, material for foreign export, through which the ryot makes his profit, and the country at large pays for its administration.

SIR RICHARD TEMPLE writes:—I regret that I was obliged to leave the meeting at which Sir Charles Elliott drew attention to a few of the conclusions to be drawn from the Indian Census Report of 1901 before I could be called upon to speak. The point in his paper which I may be able to illustrate from my own experience is that relating to the very important —all-important I might almost say in view of possible developments owing to British administration—subject of the birth and development of caste. It fell to me to write Vol. III. of the Provincial Census Reports for 1901—the Andamans and Nicobars—and among the populations I had to deal with were the descendants of the Hindu convicts sent to Port Blair. The preservation of caste among a population so unfavourably situated for such a system much interested me, and I made all inquiry into the subject possible to me in view of the census. Practically, I found the marriage system to be the one criterion of "caste"—a conclusion arrived at by most experienced observers. Among the convicts the situation is this, male and female convicts have, ever since the foundation of the penal settlement, about fifty years ago, been allowed to marry under certain strict administrative rules. But it will be understood that though the general rule in the Hindu caste marriage customs—caste to caste,

i.e., Brahman to Brahman, Rajput to Rajput, and so on—could be carried out in these marriages, the local customs which obtain within the general castes were impossible. That is, the Bengal Brahman would have to be satisfied with a Brahmani from Madras, a Rajput from Kachh with the daughter of a Rajput from the Himalayas. In all such cases the *jus connubii* would in India be held to have been broken, just as it has been broken all over India by migrations of colonies from the headquarters of castes. Therefore, in all such cases, the children would not be recognised as fellow castemen in India by the castes to which they claimed to belong. The interesting and ethnologically valuable question then is: How do the descendants of such marriages behave in the circumstances? Have they degenerated from the parent castes? Or are they preparing to maintain the caste system? The answer was quite clear on enquiry; the caste system will be maintained among these people in all its integrity locally, just as it has been maintained locally by emigrants cut off from the parent stock. This question being so answered, the next and most informing question is: How are they managing it? The great difficulty was the supply of brides of equal caste. For the handing on of absolute purity of blood it proved insuperable. There were not in the second generation locally procurable Brahman girls for all the Brahman boys, or what is perhaps of more consequence in this case, Brahman boys for all the Brahman girls at the appropriate and indeed obligatory time for marriage, and so on for all castes. This hard knot was cut thus. It was held that what really mattered was the caste of the father, that the mother (or bride) became merged in her husband's caste on marriage, and that all children were of the caste of the father. In this way, sisters became on marriage to be actually of separate castes, and first cousins to belong to different castes. The great point, however, was that locally the castes were retained in their fulness of distinction, however little it was possible to retain purity of blood in the initial stages. The next point to be noticed was that though frequently obliged to maintain caste in this irregular way, by pressure of environment, there was a never relaxed attempt as the time for children's marriage came on, to adhere to the principle of caste to caste. As this population increases, and it must rapidly do in a land where nearly all the children born are reared, no doubt this principle will gradually override that of ignoring the bride's caste, adopted as it has been, of necessity and obviously not of choice. The Census Reports of the future will show. In my report, I collected all the information and statistics available, but I was too close to the "birth" of a new caste system to collect details in sufficient quantity to prove the tendency noted. Of course, in India the Port Blair castes will not be recognised, but that is of no practical consequence as all recognition of caste is a local affair.

TWELFTH ORDINARY MEETING.

Wednesday, March 1, 1905; SIR EDWARD POYNTER, Bart., P.R.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Aldwyncle, H. J., P.O. Box 5596, Howard-buildings, Johannesburg, Transvaal, South Africa.
Biliotti, Frank, 8, John-street, Adelphi, W.C.
Bracher, Mrs. L. E., Hamilton, Waikato, New Zealand.
Cooper, William James, A.M.I.Mech.E., A.M.I.E.E., 15A, Turnpike-lane, Hornsey, N.
Crawford, William, J.P., Mount Randal, Belfast, Ireland.
Dawson, David Stewart, 20, Hatton-garden, W.C., and Hotel Cecil, Strand, W.C.
De Landero, Carlos F., Apartado 3, Pachuca, Mexico.
Denny, Harry S., P.O. Box 4181, Johannesburg, Transvaal, South Africa.
Fawcett, Francis Thomas, 135, Nag's Head-road, Ponder's End, Middlesex.
Flannery, Sir J. Fortescue, Bart., M.P., 9, Fenchurch-street, E.C.
Hadaway, William Snelling, Penrhyn-cottage, Bushey, Herts.
Hughes, F. G., Salisbury, Rhodesia, South Africa.
Hutson, Alfred Robert, 123, Darnley-road, Gravesend.
Mitchell, W. F., 26, Craven-hill-gardens, W.
Samuel, S., 11, Portland-place, W.
Smith, W. Ramsay, D.Sc., M.B., Winchester-street, East Adelaide, South Australia.
Sumner, Orlando, Dalry-house, Ashton-on-Ribble, Lancs.

The following candidates were ballotted for and duly elected members of the Society.—

Barratt, Reginald, A.R.W.S., Arts Club, 40, Dover-street, Piccadilly, W.
Beckett, Henry Barron, Mailla, The Green, Wimbledon.
Bertram, Henry, 1*a*, Cooks-road, Stratford, E.
Bonnett, Charles, Messrs. F. and C. Osler, Hornby-road, Bombay, India.
Brincker, John Augustus Herman, M.B., B.S., M.R.C.S., the Borough Hospital, Croydon,
Buck, Edward Clarke, Assistant City Engineer, Pretoria, Transvaal, South Africa.
Casey, Mark Patrick, Municipal Engineer, Lucknow, India.
Crosse, L. Arthur, J.P., R.M. Office, Nqutu, Zululand, Natal, South Africa.
Densham, Sidney Charles, 152, Adelaide-road, N.W.
Johnson, Charles Grove, F.R.I.B.A., Apartado 610, Mexico City, Mexico.
Lisbôa, Miguel Arrojado Ribeiro, M.Am.I M.E., Rua Costa Gama, Villa Japurá, Petropolis, Rio de Janeiro, Brazil, South America.

Perry, George A., 13, Carlton-road, New Southgate, N.
Redwood, Iltyd I., Bantry-house, Belvedere, Kent.
Sparrow, Reginald George, Lenton-avenue, The Park, Nottingham.
Vidyasagar, Panjabbhudana Pandit Bulakirama Sastri, M.R.A.S., Mayo College, Ajmer, Rajputâna, India.

The paper read was—

THE BRITISH ART SECTION OF THE ST. LOUIS EXHIBITION.

By Isidore Spielmann, F.S.A.

It is my intention this evening to endeavour to undertake the extremely difficult task of presenting to you in a brief space of time a description of the British Art Section of the St. Louis Exhibition which closed in December last. I want also to say a word or two upon the objects and advantages of Art Sections at International Exhibitions; I want to tell you how Art exhibitions are promoted, and I want to say something also about the work they involve, the results they achieve, and the lessons they teach.

I should perhaps preface my remarks by stating that although I helped to organise this section as a member and honorary secretary of the Art Committee, I did not go to St. Louis; but from my acquaintance with the work on this side and the abundance of material and the numerous illustrations I have collected, I am, I think, in a position to bring this section vividly before you.

The section devoted to Art is invariably regarded as one of the chief features of attraction in every International Exhibition. Without it an exhibition would be incomplete, and would be as dull and uninviting to the great majority of people, as would be a landscape without trees or water. "While manufacture is the work of hands only," said Ruskin, "Art is the work of the whole spirit of man." Art adds refinement and adornment to an exhibition, and, by the immense pleasure it affords, has not infrequently been able to turn the scale from failure to success. We should place great faith in the educational possibilities of exhibitions generally, because to many persons the knowledge derived from them is more easily, usefully, and more rapidly acquired than by reading, for the obvious reason that it is usually possible to receive it at exhibitions in a more attractive, striking and inviting form.

Exhibitions would perhaps be better understood and more fully appreciated if the public only knew how much labour, time and trouble are devoted to their organisation, and what difficulties must be overcome in their successful promotion. "How an exhibition is promoted," would in itself provide an excellent subject for a separate paper. From start to finish the subject bristles with difficulties, and difficulties we know are never absent from the formation of an Art Section. These difficulties can only be realised by those who have attempted the task. They commence with the formation of the art committee, and the efforts made to safeguard the many interests in Art representation, for every school or group of painters nowadays wishes to be specially recognised as a factor in the Art of the time.

The difficulties are met with in the attempt to draw up the right lists of artists, and to secure the right exhibits that will do honour to the country, in obtaining the works specially required by the committee from the artists, or in persuading private owners to part with their treasures, and remain content with vacant spaces in their dining-rooms for a time; or in tracing the whereabouts of pictures or sculpture that have passed through a variety of ownerships, sometimes to be met with refusal in the end. And when a good display is eventually secured, other difficulties are often present in the endeavour to obtain adequate space in which to show it, and the right location of that space. But when with plodding perseverance and unlimited patience these difficulties are eventually overcome, and the exhibition is opened, the pride with which one regards the ultimate result—only those who have taken part in such work can appreciate its pleasures.

You will readily understand that the success of an Art Section largely depends upon the willingness of artists and of private owners to place their works at the disposal of the organising committee.

There was a time—not so many years ago—when any work of art was considered good enough to send to an international exhibition with which to represent this country. I am old enough to remember, as a schoolboy, watching groups of foreign visitors to a British Art Section laughing at the works there exhibited with every justification for their merriment; but things have fortunately changed, and in recent years very searching selections are made not only of the artists to be represented, but also of the works they actually send, so that the British school in its various branches may be presented at its best and by the most

representative art only, that can possibly be procured.

As a result, the collection of British works sent to Paris in 1889 was good, that sent to Chicago in 1894 was better, but that sent to the Brussels International Exhibition in 1897, was by far the best collection of modern British Art that had ever been sent out of the country. After Paris and Chicago foreigners ceased to regard England as a barren and stony land in which the arts cannot grow; but the undoubted success of our Art display at Brussels came as a revelation to all those who were not previously acquainted with our Art, for it was in many respects the most admirable feature of the whole exhibition; not only to Belgium did this come as a revelation, but the same idea was echoed throughout Europe. As a consequence foreigners no longer express surprise when they find Englishmen who can paint and model. But the knowledge they acquired is a plant of slow growth, and it will not grow at all unless advantage is taken of each opportunity that presents itself. The British Art display at Paris in 1900 was again very good, and was generally regarded as the best of the Foreign Art Sections.

That at St. Louis—the one under consideration—I had better describe in the words of Mr. Humphry Ward, who wrote of it thus:—"The result is that, although the committee have exercised a somewhat severe method of selection, they can justly point to the British contribution in the Department of Fine Art as among the best, largest, and most important that has ever been sent from our shores. It is equal, or superior, to the display made at Chicago, better than that made at Paris in 1900, and not inferior, in the opinion of good judges, to the remarkable collection sent to Brussels in 1897."

Having succeeded, therefore, in forming a strong Art Section, the least we could expect was that it would be well housed both as regards adequate and well-situated space. At St. Louis it was unfortunately neither adequate nor well situated as compared with the positions allotted to our neighbours. The reason of this is not difficult to explain, and constitutes a disadvantage to which this country has to submit at so many international exhibitions. I have spoken of it for years past, even to Government officials, and I would like to repeat it here.

It may be fairly assumed that Great Britain is invited to participate in foreign international exhibitions at the same time as other countries, but, unlike other countries, we have no permanent and special department by which such enterprises can be organised. In France and in Germany there exist permanent Government Departments which are always ready at short notice to begin the work associated with their participation in international exhibitions. It is not so with Great Britain. Here upon the receipt by the Foreign Office of an invitation to take part in an international exhibition that Department confers with others—with the Treasury, which furnishes the funds that may be necessary, with the Board of Trade, and in the event of a Royal Commission being appointed, with the Home Office also. After considerable delay which these negotiations occasion, influential gentlemen renowned in politics, commerce, literature, science, and art, are invited to join the Commission. The time occupied by these preliminary arrangements results in Great Britain getting to work considerably later than either France or Germany, who usually have a start of us by many months, during which time they have sent representatives to visit the site of the exhibition, and to see the officials of the exhibition administration, and have in all probability secured the best positions as regards spaces in all the Sections. When Great Britain is ready to move we find to our cost that we have to take the spaces in various sections which France and Germany, and perhaps other countries also, have refused to accept—or at least, have left for us to take.

But it is not only in regard to insufficient and badly situated space that we are often at a disadvantage; the time left in which to organise a display that should be creditable to the nation, is often so short that the work has to be rushed to make up for time lost. The industrial sections as well as the Art Section are therefore often handicapped, and the art committee cannot be set to work until its constitution is settled, and the amount of its grant determined by the executive committee.

When you consider that the time required to organise an exhibition is considerably greater than it takes the exhibition to run, and that the winding-up process is an operation equally long, the time between the closing scenes of the one and the opening scenes of the next is often very short, so that a permanent department, if one were established, would not long remain idle. It might even be utilised for other purposes in between.

If it can once for all be decided that it is beneficial to this country to participate, or should I perhaps say that if we decide that our country cannot afford to be the only country to hold aloof from great international exhibitions, then we should hope to see such a department established either at the Board of Trade or at one of the other Government offices, for only then, and not till then, will Great Britain start fair at these exhibitions in competition with other countries.

If at the St. Louis Exhibition Great Britain has done well it is due to sheer hard work and not to method, or rather want of method; and I am glad to find that my friend, Mr. Walter Reid, who contributed an admirable paper to this Society a short time back on the British Industrial Sections, has come to the same conclusion.

At an early meeting of the Executive Committee of the Royal Commission for the St. Louis Exhibition it was decided to place a grant, not exceeding £12,000, at the disposal of the Art Committee, such grant to include an Arts and Craft Section.

The Art Committee was composed of the Presidents of the Royal Academy, the Royal Institute of British Architects, the Royal Society of Painters in Water Colours, the Royal Hibernian Academy, the Royal Society of Painter-Etchers, of the Royal Institute of Painters in Water Colours, the Royal Society of British Artists, the President of the Society of Oil Painters, the Honorary Secretary of the New Englsh Art Club, and the President of the Arts and Crafts Exhibition Society, together with gentlemen representing the interests of sculpture and other branches of Art.

Mr. Reginald Hunt was appointed as representative of the committee at St. Louis for the Fine Arts, and Mr. Alfred Longden for the Applied Art Section. The Committee held twenty-three meetings; many of them protracted sittings of nearly four hours, at which they considered the selection of exhibits, and here I may say that for St. Louis a new departure was tried. Instead of inviting artists to participate, it was decided as a principle to select works from those which were considered the best that had been produced during the last ten years, in oil and water colour painting, sculpture, architecture, etchings and engravings. This system of selecting works in place of artists was strictly observed, it was excellent in theory but very difficult to work in practice; it greatly increased the work, and necessitated our going through the catalogues of every exhibition that had been held during the last ten years, and of visiting all the exhibitions held during the year. It was determined that no art society would be invited to co-operate as a body, but that all works would be invited and accepted as the work of individuals and not as representing any institution, and that all exhibits should come under the head of "Great Britain and Ireland." In the case of artists applying to exhibit, it was decided that such claims to representation should be based upon their past work and reputation. And as at international exhibitions space is almost invariably restricted, it cannot at such times be regarded as suitable that the younger artists can reasonably expect to make their professional *début*. In addition to the specially invited works, many were selected by the full committee from a very large number submitted to them.

The details connected with the formation of an Art Section are numerous. Insurance for a very large sum had to be completed at an early stage before the insurance market was adversely affected, and in this connection I would state that insurance premium is one of the largest items of our expenditure. Thus, an owner is invited to lend a work, and he consents on condition that it is insured against all risks for the sum of £5,000. If you wish to have the work you must comply with the condition. The pictures sent to St. Louis were insured against all risks, namely, fire, water, theft, damage or loss, at rates ranging from 30s. to 50s. per cent. This was considered moderate, except in the case of sculpture, always a difficult class of exhibit to deal with, and which could not be insured at a lower rate than £3 3s. per cent. for bronzes, and £5 5s. per cent. for marble; plaster we did not send. It is gratifying to note that little damage occurred, the chief claims upon the insurance companies being for broken picture glasses and injured frames, and these latter are rectified before the pictures are returned to their owners.

The other business part of the arrangement includes:—Collecting the works from all parts of the country, packing them in zinc-lined cases, and their transport from London right into the Art Palace at St. Louis, the decoration of the rooms, the installation of the section, the preparation of the catalogue, all this requires a vast amount of time and thought.

Having now told you something of the work of the Art Committee, I will describe in outline

—necessarily in a somewhat faint outline—the Art Palace wherein our Art exhibit was installed.

You are no doubt aware that the vast enterprise which has just closed was devised with the intention of eclipsing all the great international Exhibitions that had preceded it. In this ambitious intention its promoters fully succeeded.

The Philadelphia Exhibition covered an area of 236 acres, Chicago 633 acres, the Paris Exhibition of 1900 336 acres, the St. Louis Exhibition of 1904, 1,240 acres, or as large an acreage as all three combined. The approximate area of the buildings alone at the St. Louis Exhibition was close upon 200 acres. The actual cost of the entire Exhibition, exclusive of the large cost for maintenance, is said to have exceeded £5,000,000 sterling.

The space allotted to the display of Art by the United States and the twenty-three foreign countries participating was on a much larger scale than at any previous exhibition, the actual area of the galleries equalling nine acres, and the cost of the four Art Palaces was about a quarter of a million sterling.

Art Palace.

Three of these buildings faced the Exhibition grounds, and had a frontage of 836 feet. Mr. Cass Gilbert, of New York, was the architect. The central building is of a permanent character and was devoted exclusively to the work of American artists. The wings or side pavilions each covered an area of 420 feet by 200 feet, and were allotted to foreign countries—the Latin races chiefly occupying the right Pavilion and the Teutonic races the left. A fourth building at the back contained large sculpture exhibits from foreign countries. This group of buildings is designed in graceful well proportioned Ionic style, accentuated at the main entrance of the central building by a Corinthian portico of majestic proportions. The architect, of course, avoided the use of window openings in order to impart to the building the accepted characteristic of an Art Palace.

The British Art Section was situated in the left Pavilion. The disadvantageous position of our rooms will be the more apparent when I explain that on the east side, a terrace separates the Pavilion from a park, and as the ground slopes rapidly from north to south, this terrace rises to a considerable height, making it and the south main entrance inaccessible from that direction. A main road with a good entrance would naturally have brought many visitors from that side, especially as the railway passes this point.

Owing to the repeated representations of our Chairman, ably supported by Colonel Watson, our Commissioner-General at St. Louis, this serious drawback was at a later date somewhat remedied by the exhibition authorities constructing a flight of steps from the lower level to our terrace as had been originally promised. On the west, our section could be entered by one doorway leading from the gardens into galleries J and K.

To reach our galleries from the grand entrance at the north side it was necessary to pass through those allotted to Germany and Holland, and it is obvious that the great majority of visitors came to our rooms after having already seen many other pictures, and possibly with appetites too jaded to be ready for further artistic enjoyment.

A glance at the plan on the screen will show that to Germany was accorded not only the best position in this wing, as France was accorded in the corresponding wing, but also a larger amount of space than was allotted to Great Britain.

On the day of the official opening of the Exhibition our Art Section was complete in almost every detail, whilst those of our neighbours, including America herself, were unfinished and consequently closed to the public. As the south entrance was not accessible, only a small percentage of the public found its way to our galleries through the unfinished German and Dutch Sections, whilst those of France in the other wing, which showed a portion of her exhibits, were thronged.

Our galleries, with the exception of K and J, devoted to architectural drawings, were lighted from the top, but it was necessary to diffuse the light by means of a velarium of unbleached muslin, and before the summer months every room was properly shaded.

Decoration.

The walls of our galleries devoted to pictures and drawings were hung with a silky-red burlap; those devoted to the Applied Art exhibits with a biscuit-coloured burlap; the dados and doorways were painted white, and this crimson and white decoration gave a gay effect to our section and distinguished it not unpleasantly from those of other nations, in all of which the colouring was subdued and neutral. Our floor covering, a linoleum of a neutral green shade, harmonised effectively with the surrounding decoration. The effect

of our frieze was decidedly good. It was designed, and for the most part, painted by Mr. Walter Crane, President of the Arts and Crafts Exhibition Society, and a member of the Art Committee. The scheme consisted of a series of shields connected by scrolls of foliage. Inscriptions on the scrolls refer to the contents of the various galleries, those in the Applied Art Section refer to the aims of the arts and crafts movement—the unity of design and handicraft in adaptation, material, and use. In the frieze-panels appear the shields of H.R.H. the Prince of Wales, President of the Royal Commission, the Royal Shield, and about a dozen other shields connected with a design of decorative foliage. You will be able to see the many variations of the frieze presently in the illustrations on the screen.

Mr. E. J. Gregory, R.A., P.R.I., and Mr. Alfred Parsons, A.R.A., were kind enough to proceed to St. Louis to hang the pictures and place the sculpture. They reported that the number of doorways seemed excessive, and they obtained considerable wall space by closing some of them. As I have said, the space given to Great Britain and Ireland was smaller, in proportion to the size of our exhibit, than that provided for most of the other countries, and our pictures had to be hung more closely than would have otherwise been the case. But in the matter of oil paintings and water-colour drawings it was found possible to leave a narrow space between each. A great effort was made to secure Gallery No. 69, but without success, although we understood that it had originally been promised to us.

Messrs. Gregory and Parsons considered that Gallery 81 assigned to water-colour drawings was not large enough for the very representative collection sent over, and they therefore had to utilise three walls in Room 80, reserving the fourth wall for pastels and for small oil paintings. With few exceptions they were able to show to equal advantage the pictures of all schools of British art, and of every class at least one work of each artist represented was placed on the line. In hardly any case was it found necessary to hang more than two lines of pictures, and every picture accepted by the committee was placed in a position where it could be well seen.

Results and Comparisons.

I have prepared a Table showing the number of works sent by Great Britain to the last five international exhibitions. You will note that we contributed to St. Louis nearly 300 oil paintings, about 150 water-colour drawings, 90 pieces of sculpture, nearly 300 engravings, etchings, and drawings, and nearly 200 architectural drawings; in all 1,025 works representing 550 artists and architects. (Table I.)

TABLE I.—Showing number of British Works of Art at the last Five International Exhibitions.

	Oils.	Water Colours.	Pieces Sculpture.	Black and White Drawings.	Architectural Drawings.	Total.	Artists Represented.	Exhibits per Exhibitor.
Paris, 1889......	172	124	40	123	93	552	300	1·84
Chicago, 1894 ..	461	204	53	266	146	1,130	515	2·19
Brussels, 1897 ..	205	109	24	222	54	614	259	2·33
Paris, 1900......	166	89	54	114	47	470	282	1·67
St. Louis, 1904 ..	293	158	90	294	190	1,025	554	1·85

I have prepared a second Table showing how we compared with foreign countries in the number of works we sent, and it will no doubt strike you that both our section and that of France were very large in comparison with that of the United States. (Table II.)

In the Applied Art Section we also exhibited very largely in comparison with other countries. I will return to this section presently.

To complete our comparisons I have prepared a statement of expenditure of the British Art Sections at the last five international exhibitions. We had at St. Louis, 554 exhibitors in the Fine Art Section, and 152 exhibitors in the Applied Art Section, making a total of 706 exhibitors. The Royal Commission made a grant of £12,000 for the entire Art Section, which is equivalent to £17 a head as against £19 at Paris, and £22 at Chicago. (Table III.)

As I have said, the entire British Art Section was completed in time for the official opening

on April 31, 1904, and was the only one which had its catalogue on sale to the public. For a considerable time after the opening ours was the only catalogue obtainable in the Art Palace. Not even was the American catalogue ready. It appeared only in June or July I think. This was the case also in all the other sections of the Exhibition, where the British Industrial Catalogues were, I believe, the only ones to be had for many weeks. We may pride ourselves on the fact that this was the case also at Brussels, 1897, and at Paris in 1900.

In studying the collections as well as the decoration of the galleries of the various nations, a distinct and characteristic expression of individuality of style is readily noticeable. I would like to show you one or two illustrations of the galleries of other countries so that you may, by comparison, be able to fo m a better judgment of our own.

The illustration on the screen is of one of the rooms in the American Section. It is from a block print, and is not very good.

The central portrait on the north wall is that of the Empress of China, by Miss Carl, a citizen of the United States, and the following reference to it from our representative at St. Louis is rather amusing:—"It is," he says, "The only portrait that has been painted of the Empress, and represents her seated on a throne in Eastern costume. Miss Carl was not allowed to paint the portrait in the way she wished, and had to follow the instructions of the Empress. When the picture was finished and removed from the precincts of the sacred city, it was considered to be in some sense a part of the Empress herself, and it was thought necessary to clean up the streets and decorate the passages from the palace to the river where it was shipped. The cost of repaving the streets and generally decorating the route is said to have exceeded £2,000. The portrait

II.—Comparative Table showing number of British and Foreign Works of Art at the St. Louis Exhibition.

Country.	Group 9. Oils and Water Colours.	Group 10. Engravings, Etchings.	Group 11. Sculpture Exhibits.	Group 12. Architectural Drawings.	Total. Fine Arts.	Group 14. Arts and Crafts Exhibits.
United States	1,619	337	354	289	2,599	945
France	661	318	308	48	1,335	195
Great Britain	560	185	90	190	1,025	411
Germany	330	72	124	63	589	53
Russia	533	4	14	—	551	39
Holland	242	132	28	24	426	60
Italy	243	11	102	4	360	13
Austria	226	23	51	13	313	187
Belgium	218	9	55	8	290	—
Sweden	118	4	45	—	167	—

Table III.—Comparative Statement of Expenditure of British Art Section.

Exhibition.	Collecting, Packing, Transport and Redistributing. £ s. d.	Insurance. £ s. d.	Decoration of Section and Installation. £ s. d.	Salaries, Wages, &c. £ s. d.	Total. £ s. d.	No. of Exhibitors.	Cost per Exhibitor. £ s. d.
Paris, 1889	1,322 0 0	1,225 0 0	617 0 0	700 0 0	3,864 0 0	300	12 17 6
Chicago, 1894	4,439 0 0	4,438 0 0	685 0 0	1,768 0 0	11,330 0 0	515	22 0 0
Brussels, 1897	1,167 12 11	1,210 13 2	166 0 0	400 0 0	2,944 6 1	259	11 7 0
Paris, 1900	2,132 4 7	1,391 1 1	848 4 4	1,020 14 8	5,392 4 8	282	19 1 6
St. Louis, 1904 (Including an Arts and Crafts Section)	4,515 5 2	2,897 9 10	1,957 5 10	2,573 19 5	11,944 0 3	706	17 0 0

arrived at St. Louis in charge of an escort of eleven Chinese, headed by Prince Lung. It was in a huge case, and occupied a tremendous time to unpack, and the men were only allowed to handle it with their hands covered with silk. The picture itself was wrapped round and round in silk, and was contained in a specially sealed case. The portrait had to be held constantly in an upright position out of respect to the Empress. It is a gift from the Empress to the American Government.

The walls of the United States Galleries were decorated with red or pale green jute, while the friezes by Charles S. Holloway, representing seated female figures with garlands of flowers containing the names of the prominent American artists, harmonised with the decoration of the walls.

The French Section contained the largest collection of pictures and sculpture that has ever been sent from that country, and was fairly representative, although it appeared that many of the most distinguished artists were not represented by their best works.

The scheme of colouring dominating their section was a neutral red, and the frieze was from a design by Besnard. It consisted of a conventional figure closely repeated; the colours employed being a deep golden brown, blues, and red.

The large space allotted to Germany was chiefly occupied with enormous historical canvases from the public galleries that had been painted by Imperial order. They are said to have been interesting historically, but from the artistic standpoint of less importance than many works that might have been included with greater advantage.

The chief gallery assigned to German art exhibits, as in Paris, was decorated with a somewhat monumental treatment of the walls, but the general effect is said to have been dignified and serious.

Holland sent a good collection of works by her best artists, and the decoration of her section was made up of broken greens and greys, with a frieze in which dull purple and dark green harmonised well with the walls.

The scheme of colouring in the rooms of the Belgian Section was of russet and gold, and in their frieze the names of the great masters of the Flemish school were introduced. Belgium's art exhibit, I understand, was stronger in sculpture than in painting.

The Italian Section was again disappointing. It is unfortunate that Italy has failed to make a favourable impression in modern art at recent international exhibitions. The decoration of their walls and their frieze, however, were good and original, and were embroidered in harmonious colours.

Japan had a large exhibit of noted examples of their old school of art, as well as paintings by younger artists in the European style. She also sent a large collection of sculpture in ivory, wood, and bronze, which greatly enhanced the success of her section. The decoration of the Japanese rooms consisted of a general scheme of colours of positive tints, green and blue predominating, and the frieze was by Japanese artists, who worked it direct on to the walls.

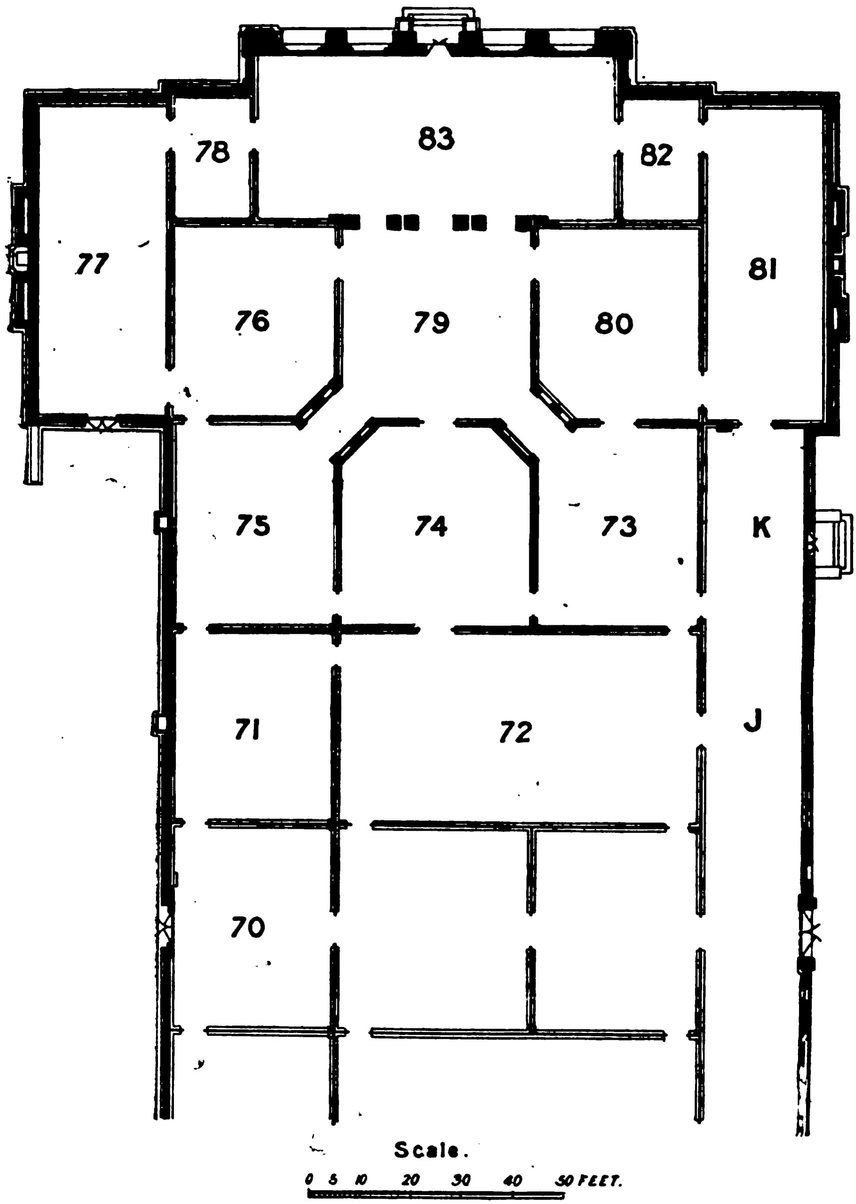
And now I will ask you to accompany me through our galleries, following them in their order on the plan. To save time, I propose showing but one general view of each gallery, and then a few special works contained in each. It is manifestly impossible to show you all of them.

To make a selection at all is extremely invidious, and it has therefore occurred to me that it would be interesting to place before you some amongst those works which appear by general consensus of opinion to have most impressed local critics and visitors. This seems to afford the only basis on which I can make a selection—quite apart from the question of the excellence of photographs available. Besides, it is always interesting to know the impression that is made upon others than ourselves. And I must invite you to accompany me round the galleries as your "guide" who has learnt his way, and not as a critic.

The first room approached from the German Section is No. 70, which was devoted exclusively to black and white work; drawings in pen, pencil and chalk, etchings and engravings, too many I fear to show to advantage in the limited space; but we were anxious to have the collection as complete as possible, and few, if any, of our most important men were absent. Not only were our etchings both good and representative, but we had no reason to be ashamed of the examples of our characteristically English art of mezzotint displayed. Here we were able to show upwards of twenty very fine drawings by Burne-Jones, a dozen by Leighton, and several by Sir Seymour Haden; and ninety other eminent artists exhibited in this section.

Room 71 is the first of those devoted to oil paintings. Here in the centre is Orchardson's

portrait of "Sir David Stewart, late Provost of Aberdeen." Without in any way criticising the work I ought to tell you that this superb picture produced an immense impression at St. On the left—(1) "Wet Sands," by William McTaggart, R.S.A.; (2) "Portrait of Admiral Fisher," by A. S. Cope, A.R.A.; and (3) Ernest Parton's, "In the Tangled Wild Wood."



Plan of British Art Galleries.

Louis. On the right are—(1) "The Pilot," by Napier Hemy, A.R.A.; (2) "The Portrait of Professor Kennedy," by Hugh Riviere," and (3) "Evening's Twilight," by J. E. Grace, R.B.A. Above is John Lorimer's "Idyll Autumn." Above is Fred. Appleyard's "Easter Time." The room contained many other well-known pictures: "Brown Autumn," by Alfred Parsons, A.R.A. The picture was painted on the upper Thames above the point where

its junction with the Severn Canal makes the river navigable for barges. "God rest ye merry gentlemen," by Seymour Lucas, R.A., one of those delightful Christmas carols of the 17th century; "Portrait of Mrs. Reynolds and Daughter," by Luke Fildes, R.A.; "The Flowing Tide," by Moffat Lindner, N.E.A.C.; "The Storm," by Julius Olsson; "The Fracture," by William Orpen, N.E A.C. A point of great interest in this picture is that the room represented is that in which Thackeray lived in Soho and wrote "The Newcomes." The artist's intention is an exercise in the rendering of light. "La Belle Dame sans Merci," by Frank Dicksee, R.A. The idea is taken from Keats' ballad, and depicts the passage—

"I set her on my pacing steed,
And nothing else saw all day long,
For sidelong would she bend and sing
A faery's song."

La Belle Dame, in a gown of rose-colour and silver, her red floating hair shadows the knight as she bends over him. He is held by the magic of her thrall, an ecstasy of wonder and devotion possesses him. Under this spell he is taken to her grotto to be lulled asleep, to dream dreams and to meet the fate awaiting him.

Room 72 contained a large number of important works, many by Scottish artists. In the centre was Sir John Millais' "Chill October," one of his best-known and finest works, lent by Lord Armstrong, which you will see again presently; above it, "On the Threshold," by Ernest Normand. On the right — (1) Millais' "Portrait of Cardinal Newman;" (2) the President's picture, "The Catapult;" (3) "The Lilypond," by G. D. Leslie, R.A.; (4) "Scene from Enoch Arden," by J. Sant, R.A. On the left — (1) Sir John Millais' "Portrait of Sir James Paget;" (2) the President's "Greek Dance;" (3) A sea-piece by J, C. Hook, R.A. In this room were also Lord Leighton's "Perseus and Pegasus with the head of Medusa;" "Portrait of Cardinal Manning," by W. Ouless, R.A.; "The Dream of Launcelot," by Burne-Jones; "Portrait of Lord Charles Beresford," by Charles Furse, A.R.A.; and pictures by Peter Graham, R.A.; W. F. Yeames, R.A.; Briton Riviere, R.A.; the late Val Prinsep, R.A.; Ogilvie Reid, R.S.A.; Byam Shaw, and T. B. Kennington; and the "Portrait of Sir Walter Gilbey," and "The Borgia," by W. Q. Orchardson, R.A.

"Chill October," by the late Sir J. E. Millais, R.A. Pasted on the stretcher at the back of this picture is a sheet of paper, on which the painter has written the following note:—

"'Chill October' was painted from a backwater of the Tay just below Kinfauns, near Perth. The scene, simple as it is, had impressed me years before I painted it. The traveller between Perth and Dundee passes the spot where I stood. Danger on either side—the tide which once carried away my platform, and the trains which threatened to blow my work into the river. I chose the subject for the sentiment it always conveyed to my mind, and I am happy to think that the transcript touched the public in a like manner, although many of my friends at the time were at a loss to understand what I saw to paint in such a a scene. I made no sketch for it, but painted every touch from nature, on the canvas itself, under irritating trials of wind and rain."

"Fantasie en Folie," by Robert Brough, A.R.S.A., the able young artist whose life was so sadly cut off by the terrible accident which recently occurred on the Midland Railway. This picture attracted great attention when it was exhibited at the Royal Academy, and still more at St. Louis. It represents a lady in black, seated in profile, contemplating a Chinese idol.

"The Portrait of J. C. Hook, R.A.," by Sir John Millais, is generally considered, with the possible exception of his "Sir Gilbert Greenall," the finest and most brilliant portrait he ever painted of a man.

One can hardly look at a fine portrait like this without recalling Ruskin's famous saying that, "The highest thing that art can do is to set before you the true image of the presence of a noble human being. It has never done more than this and it might not do less."

"The Avenue," by D. Y. Cameron. This picture was greatly appreciated at St. Louis, quite as much as at the Brussels Exhibition, and was considered a good typical example of the Scottish school. The prevailing notes of colour are rich olive, brown, gold and rose.

"The Auld House," by J. Macaulay Stevenson, is a picture which in feeling, of course, reminds one of Corot. The house is really a very inconsiderable item. The lake and its reflections of trees with undergrowth and atmosphere charged with moisture, are characteristic of the painter's work.

"Portrait of W. W. Robertson, Esq., Master of the Merchant Company of Edinburgh," is considered an excellent specimen of the work

of Sir George Reid, late President of the Royal Scottish Academy. Sir George also sent a "Portrait of Tom Morris," the celebrated golfer.

"The Borgia," by W. Q. Orchardson, R.A. Cæsar Borgia is best remembered for the remorselessness with which he rid himself of those who stood in his way. He generally did so by inviting his intended victim to a banquet, at which he would challenge him to drink wine, served to the doomed man in a poisoned cup, the other guests stealing away, for "to drink with the Borgia" was an honour which became synonymous with death.

Mr. Orchardson's other works at St. Louis were his portraits of Sir Walter Gilbey and Sir David Stewart.

In Room 72, "The Image Finder," Bronze statue by W. R. Colton, A.R.A. A work of much originality and strength, and interesting in motive.

"A Wounded Leopard"—in bronze, by J. M. Swan, A.R.A. This bronze is a fine specimen of casting by the *cire perdué* process. It represents an East-African Leopard pierced through the shoulder and fore-arm by an arrow; the head of the arrow is bitten off and fallen, and the animal is biting and tearing at the remainder It is a life-size work about three feet square at base and three feet high, and was begun and executed for Mr. George Jay Gould of New York, by whom it was lent. The finished bronze has never been exhibited here, only an early sketch of the work in plaster.

Room 73 contained:—Mouat Loudon's "Alas, that Spring should vanish with the rose;" David Murray's "Braes of Yarrow;" J. Young Hunter's "Forest Lovers;" Sir Wyke Bayliss' "The Sanctuary in the Certosa, Pavia;" Leighton's "Clytemnestra;" W. Hatherell's "River Picnic;" Perugini's "The World Forgetting."

On the opposite walls were, amongst others, Solomon J. Solomon's "Portrait of Mr. J H. Levy;" Marcus Stone's "Soldier's Return;" John Collier's "Prodigal Daughter;" Arthur Hacker's "Leaf Drift;" and H. von Herkomer's well-known and widely exhibited picture, "Makers of My House," which represents his father and his two uncles.

"The Doll's House," by William Rothenstein, N.E.A.C When I asked the artist to describe this picture he replied that he had wanted to paint a man and a woman suggesting something of a mystery which underlies all life, and something of the dramatic possibilities of every situation. The title was only thought of when the picture was first exhibited in Paris. It was suggested partly by the room and partly because there seemed to be something akin to the lack of finality in Ibsen's semi-tragic plays. The only pieces of sculpture in this room were:—"Robert Burns," a statuette, by W. Hampton, and "Cock and Snake," bronze group, by J. H. Furse.

In Room 74 was Leighton's "Perseus and Andromeda;" Henry Moore, R.A., the greatest marine painter of his day, "Storm Brewing" and "St. Alban's Race;" Arthur Nowell's "Portraits of his Sons;" "The Sawing Horse," and "Tucking the Rick," by H. H. La Thangue, A.R.A.; J. E. Christie's "Pied Piper of Hamlin;" "The Duck Pond," by Fred Hall.

In the same room were—"Washing the Beggars' Feet," by Sir James Linton, R.I., and works by Edward Stott and George Haité, and three by Sir Lawrence Alma-Tadema, R.A.

The well-known "Shrine of Venus" is one of the three Sir Lawrence sent to St. Louis. It represents a hairdresser's shop, classically imagined. The shop is in the middle plan, through which the clients have to pass. On entering the inner room they deposit a small offering, lay the usual marigold or a rose on the table before the Shrine, in which is a statue of Venus.

This picture now finds a home in America, where so many works by this artist now are. It changed hands during the Exhibition, and I am able to let you see it once more, by the courtesy of the Berlin Photographic Company.

"The Rainbow," by P. Wilson Steer, N.E.A.C., was painted at Bridgnorth, near the town through which the River Severn flows. It was the object of the artist, like so often that of Constable, to give the sparkle on foliage while a shower is falling, the effect being late afternoon towards autumn.

"Cave of the Storm Nymphs," by Sir E. J. Poynter, P.R.A. The picture is intended to suggest the indifference of nature to destruction, and the worthlessness of the prizes of life in the face of the elements. In the presence of the artist it could hardly be becoming in me to dilate upon its beauties.

"The Quartette," by the late Albert Moore, one of the most charming of that artist's works. It is quite remarkable for the grace of its artistic drapery and its exquisite colouring.

"Hylas and the Nymphs," by J. W. Waterhouse, R.A. The story you will recollect is that Hylas, a Greek youth who was sent to fetch water from a certain pond situated amongst some hills, was carried down by the water nymphs. This is one of Mr. Waterhouse's best pictures, and was kindly lent by the Corporation of Manchester.

"The Rick Yard," by George Clausen, A.R.A., was also in this room, but this picture, like so many others, would not photograph well.

In Room 75 the centres were occupied by—(1) "The End of a Glorious Reign: The Funeral of Queen Victoria," by John Charlton; (2) "The Homage-giving, Westminster Abbey: Coronation of Edward VII.," by J. H. Bacon, A.R.A.; (3) "Washington's Farewell to the Army," by A. C. Gow, R.A. We also had in this room:—"The Dream Princess," by Mrs. Stanhope Forbes, A.R.W.S.; "Bolton Abbey," by David Murray, R.A.; "Alpine Scenery," by J. MacWhirter, R.A.; "A Sea Maiden," by Herbert Draper; and "Warkworth Castle," by Sir Ernest Waterlow, R.A., is the ancient stronghold of the Percys in Northumberland. It is picturesquely situated two miles from the sea, and is painted in Sir Ernest's happiest and most dignified manner.

Room 76.—Here we had: "Shrimpers," by R. McGregor, R.S.A.; "A Higland Solitude," by A. K. Brown, A.R.S.A. "Portrait of Tom Morris, the Golf Player," by Sir George Reid, R.S.A.; "Drowsie Cronies," by R. Alexander, R.S.A.; "In the Highlands," by Peter Graham, R.A.; "Serena Found of Savages," by T. B. Kennington; "Across the Snow they Travel," by Joseph Farquharson, A.R.A. On the other wall, "British Wild Cattle," by H. W. B. Davis, R.A., and a "Portrait of Mrs. Denny," by W. W. Ouless, R.A. I regret that a few of these and many others besides did not photograph sufficiently well to allow of slides being made of them.

"Boulter's Lock," by E. J. Gregory, R.A. This picture represents the most characteristically crowded part of the Londoner's playground. The time is about five o'clock on a Sunday afternoon, rather late in the season, when the deep lock with its struggling occupants is full to the brim of shadow, but still girt by a sunlit landscape, into which they strive to emerge. The artist is himself afloat, in two different boats. When this picture was shown at the Brussels Exhibition, there was, in the French Section, another rendering of the same subject; it was curious how Mr. Gregory's version seemed to wipe the Frenchman's out of artistic existence.

Room 76.—"King Edward I.," bronze equestrian statue, by Hamo Thornycroft, R.A. It represents the great Monarch and law-giver mounted on horseback, with a Plantagenet shield slung at his back, and holding in his right hand the famous Statute of Winchester. This was originally designed for the great competition for the decoration of Blackfriars-bridge, 20 years ago. Having got this fine model from Mr. Thornycroft, the Sewers' Committee of the City of London took fright, and decided not to venture any further action—beyond the consideration of its sewers. At least, nothing has since been done.

"Castles in the Air," a statuette and pedestal in metals, marble and inlays, by W. Reynold-Stephens. This is an attempt to embody a child's profound realisation of a wonder story. A little girl of about two years leans back in a chair of enchantment, which stands upon a pedestal, the design of which is based upon fairy-castle forms. Flowers of fancy decorate the chair which is capped by a wonder-castle in mother of pearl.

Here in Room 77 we had "Surrey's Pleasant Hills," by B. W. Leader, R.A.; "The Return from the Ride," by the late Charles Furse, A.R.A., N.E.A.C. The portraits are of Mr. and Mrs. Aubrey Waterfield—then Miss Lena Duff Gordon. This was one of the most noted pictures in the Royal Academy in 1903, and was praised by all the critics as being finely designed, ably drawn, good and original in colour, and altogether a strong and remarkable achievement. Unhappily, as you know, Charles Furse died last year.

"Shrimpers off the Coast of Brittany," by R. McGregor, R.S.A. The exquisite golden tone of the sun-burnt faces and hands against the silvery grey of the sea and sky were the artist's chief motive in painting this picture. On the opposite wall were:—"Portrait of Lady Hickman," by A. S. Cope, A.R.A.; John R. Reid's "Rival Grandfathers," an old picture; the late M. Ridley Corbet's "Sunrise."

"The Cider Press," by Frank Brangwyn, A.R.A., in which we have one of those compositions, founded apparently on a simple natural scene, which yet contains so much more than we ever realise at one time. Though the "Cider Press" gives the title to the picture, we feel that the artist's mind has been occupied with the enduring conditions of natural

human labour, perhaps even more with the perennial beauty of sunlight, and, above all, of noble design.

"Venus and Anchises," by Sir William Richmond, R.A., deals with a theme as old as human nature,—the association of love with the renewed life in springtime. This is one of Sir William's most successful pictures, and was lent by the Walker Art Gallery at Liverpool.

"The Edge of the Somme," by Alfred East, A.R.A., is a decorative picture. Its colour scheme consists of a series of yellow greys and ivory white. The sentiment it expresses is the quiet of an early morning. It was painted in London from sketches and studies made in the beautiful valley of Amiens. In the immediate foreground, the cool white colour of the swans forms a pleasing note in relation to the warm white of the sky.

Room 80.—This room was devoted to small oil paintings and to water-colour drawings, but they are on too small a scale for you to see much of them. Here were:—

"The Wavelet," bronze statue by W. R. Colton, A.R.A., representing a girl playing with the water that trickles over the rock. It attracted great admiration among the visitors.

"The Habit does not Make the Monk," a small oil painting by the late G. F. Watts, R.A., is one of that playful character which Mr. Watts affected more and more as age came upon him.

The "May Morning on Magdalen Tower, Oxford," by W. Holman Hunt, is the finished study for the large picture. On the First of May at sunrise, for many generations, the choristers of St. Mary Magdalen College, Oxford, ascend with a band of music to the top of the tower belonging to their seminary and sing the Hymnus Eucharisticus.

"St. Theophilus and the Angel" is an important water colour by the late Sir E. Burne-Jones. After the death of Dorothea, as St. Theophilus was returning to the Courts of Law, there met him on the threshold an angel bearing a basket of fruit and flowers, who, saying, "My sister Dorothea sends these to thee from the place where she now is," vanished. Theophilus, pondering all this, came at last to the true belief, and in it died.

"The Prioress' Tale," also by Sir E. Burne-Jones. This, as you will remember, was the last work completed by the artist.

We now come to the water colours. To them Room 81 was devoted exclusively. This collection came under close observation and criticism, in view of our claim that water-colour painting is our national art. I now show you a few examples that were here exhibited.

"The Battle of the Standard," by the late Sir John Gilbert. P.R.W.S., so-called after the remarkable standard which was set up by the English at Northallerton during the war between King Stephen and King David I. of Scotland in 1138, an exceedingly powerful drawing.

"Cumberland Moors," by the late Tom Collier, R.I., is an excellent example of his admirable work. Tom Collier was essentially a water-colour painter of the first rank, and by his untimely death in 1891 English landscape art lost an artist whose work rivalled that of David Cox in quality.

"The Battle of Flowers," by R. Anning Bell, R.W.S., shows a silvery grey hall, in which a vigorous battle is going on between two parties of girls in loose flowing garments. Everything is in movement, for movement is the *motif* of the drawing; the wide loose dresses swirling out from the girls, or here and there pressed close to their form, as the action varies.

In "Andromeda," by Arthur Rackham, A.R.W.S., the subject chosen is the moment when the great sea-monster is approaching to devour his victim. He is grey-scaled and slimy like a fish, with webbed feet, and comes from the gloom of a cavern, crawling over the rock at the foot of which is Andromeda chained. The colour is rather grey and subdued; the drawing of the monster, wonderful. Mr. Rackham is a specialist in dragons!

"Melisande," by Mrs. Adrian Stokes. Melisande is seated on a rock in a weird forest, gazing dreamily in the water where her crown lies. The story does not tell what crown it is, or where Melisande came from; but she hates the crown and does not wish ever to touch it again. There is no other note in the picture than red, black, or white. "The Thorny Path of Knowledge," by J. Walter West, R.W.S.—a dainty little picture of a young Quaker mother teaching her child to read—is a typical work by one of the most brilliant of the younger Associates of the R.W.S. "A Valkyrie," by Edward R. Hughes, R.W.S. This Valkyrie leaves her Valhalla, and is soaring above a city formerly the scene of strife and heroism, but now at rest from warfare and asleep in the moonlight. The artist intends her to seem peering into the depths from the back of her winged war-horse, as though she had a great longing to live with

mortals in their beautiful city, through whose heart flows for ever a life-giving river. Sir Francis Powell, P.R S.W., John Fulleylove, R.I., the late Charles Green, R.I., Dudley Hardy, R.I., and Yeend King, V.P.R.I., as well as the Presidents of the Water-colour Societies, were all represented in this room.

The sculpture exhibited here included:—"Hymn to Demeter," in bronze, by Horace Montford, representing a girl marching in procession as she sings her hymn. She fits her steps to the music, the measure ever varying, her body bending and swaying to the same rhythm.

"Love and the Mermaid," a bronze group by Charles J. Allen, is supposed to represent Cupid, love-god of the earth and air, who has wandered on to an outlying ledge of rock, and encountered a rival power in the witchery and charms of a Mermaid instinct with love and the sea. He stands bewildered and fascinated, and likely to fall a half-willing prey to the wiles of the fair captor.

"Boy with Top," a bronze by E. Roscoe Mullins, is a fine rendering of nature.

Gallery J and K was devoted to Architecture. Here 200 works represented 70 of our leading architects. It is impossible to read so long a list of names, but I think I can safely say that very few eminent men in that profession were unrepresented. British architecture, as is universally admitted, has made great headway of late, and the carefully selected works sent to America for this section must have convinced the public that we have able architects as well as painters and sculptors.

The works on the left screen should, strictly speaking, have been exhibited with sculpture. They are magnificent photographs of the model of Mr. Brock's Memorial to the late Queen Victoria. The top one is a single photograph and is seven feet long by five feet in height; this will give an idea of the length of the gallery.

Room 79 connected the Fine Art with the Arts and Crafts Section, which you see through the columns. The pictures here:—"The Brook," by Leslie Thomson, R.I.; "Saving the Colours by the Guards at Inkermann," by Robert Gibb, R.S.A.

Room 79A.—The main collection of sculpture, although small, was representative, only one or two eminent sculptors being absent. Many of the busts and groups were placed round the walls of Gallery 79, where they showed to great advantage and added largely to the general effect. Some of the smaller bronzes, as you have seen, were grouped upon pedestals in Gallery 72 and round the Water-colour Gallery 81.

The short passage leading from Gallery 79 to Galleries 73 and 75 was well lighted from the side, and afforded good positions for a few bas-reliefs.

The following were among the chief sculpture exhibits:—

"Eve," a bronze statuette by Thomas Brock, R.A., represents the Universal Mother standing with her head bent forward, her left hand on her breast, and her long hair falling down her back and over her shoulders, the serpent coils round the base, which is circular in general form on a square plinth.

"The Sluggard," a masterpiece, if not the masterpiece, in sculpture by the late Lord Leighton is too well known and appreciated to need praise. The sluggard presses a laurel wreath under the heel of his right foot, a touch of morality, unlike Leighton's usual practice, being introduced.

"Teucer," in bronze, by Hamo Thornycroft, R.A., was, you will remember, the Homeric bowman famous at the Siege of Troy.

"The Kiss," by A. G. Walker, is a work which was carved direct in the marble, no preliminary clay model having been made, but merely a shaded drawing on the marble slab.

"Snowdrift," by the late E. Onslow Ford, R.A., is a recumbent female nude figure in white marble on a plinth of Mexican onyx. This charming work is one of the artist's last works, and was exhibited in the Royal Academy in 1902. It is about four feet long.

"Mother and Child," the beautiful bronze bust by George Frampton, R.A., includes the portraits of Mrs. Frampton and the artist's son; the group is life-size.

"The Spirit of Contemplation," a life-size bronze figure of a girl reclining in a neo-classic seat decorated with small figures of Courage, Philosophy, Life, Love, and teh like. The work is by Albert Toft.

"Psyche," bronze ideal head, by F. Lynn Jenkins. In it the sculptor, who is perhaps best known as a decorative worker, has aimed not merely at reproducing beautiful form from Nature but also at expressing the less tangible beauty of the soul underlying.

"Age of Innocence," bronze bust by Alfred Drury, A.R.A. An ideal bust of a child in which the sculptor endeavoured to portray the

innocence, simplicity, and *naiveté*, and above all, the young flesh of childhood.

"The Breton Peasant," by Professor Lantéri. The original of this bust in bronze is at the Musée de Luxembourg, and also at the Tate Gallery (each claims to have it!) It was modelled as a practical demonstration before some French sculpture students in the north of France.

"The Last Song," by H. Pegram, A.R.A. The idea is that of an old soldier dying, to whom a maiden comes and sings of his past deeds and future reward.

Room 83, with the two small rooms, 78 and 82, contained our Arts and Crafts exhibits, or, as the Americans termed them, original objects of art workmanship.

For the first time in the history of international exhibitions, these were shown on a large scale side by side with the fine arts. A similar course was attempted at Chicago, but the response was then but meagre. Our American friends decided that at St. Louis the line which has hitherto separated applied art from the fine arts should be obliterated, and that, under the broader classification, any work, whether on canvas, or in marble, plaster, wood, metal, glass, or in textiles, is equally deserving of recognition from the standpoint of conception and technique. The unity of art, therefore, which lay at the root of William Morris' teaching, was fully recognised at St. Louis.

As you are probably aware, these artists, or groups of artists, work co-operatively, and both design and execute the works they produce. The United States exhibited nearly 1,000 original objects of art workmanship. Great Britain came next with over 400—the largest collection of its kind we have ever contributed to any exhibition. France followed with nearly 200 objects, and the other countries were far behind.

In the selection of their exhibits, the Arts and Crafts Sub-committee, presided over by Mr. Walter Crane, R.W.S., had a completely free hand, and Mr. Halsey Ricardo went to St. Louis to arrange them.

Room 83A.—Testimony should here be borne to the very great beauty of the bookbindings that were sent, besides the artistic pottery, dainty and elegant glass, refined jewellery, brilliant enamels and illuminations, which completed this intereting collection, and I am only sorry that time does not permit of my selecting individual objects for your closer inspection.

These were some of the chief features of this display of British Art which has now been dispersed: but I must repeat that amongst the remainder which you have not seen were numerous works of equal interest. Some of them I hope to include in the Illustrated Souvenir which I am preparing for the Royal Commission. They may also be seen by reference to our catalogue, of which a few hundred copies remain, and can be obtained on application to the offices of the Royal Commission for the St. Louis Exhibition, 47, Victoria-street. It is a useful book, and contains, besides the catalogue of the Fine Arts and Applied Arts Section, a condensed "Who's Who" of over 550 eminent British artists and architects.

It is a matter of some interest that our section was the first to be dismantled and packed up, and that we were the first to get away. In this we were not assisted by the United States Customs and other Administrations, and we found that it is even more difficult to get things out of the country than into it. They evidently parted with us with great reluctance.

The United States duty upon paintings in oil and water-colour is 20 per cent. *ad valorem*, upon black and white drawings it is 25 per cent. *ad valorem*, whilst the duty upon pictures imported into the United States from France, Germany, Italy, &c., is but 15 per cent. It is difficult to suggest a reason for this preferential tariff in favour of non-British countries, but the cause is probably to be sought in the fact that they are able to offer some corresponding advantage to the United States. The artists of Great Britain are selected as the victims—though not the only victims of the open door which Great Britain throws wide to all comers—and they are consequently compelled to pay considerably higher duty than their foreign rivals. The duty upon bronzes is 45 per cent. A picture, as I have said, has to pay 20 per cent. of its value, but the duty upon its frame is 35 per cent. of its value, and 45 per cent.—if covered with gold leaf. The duty upon groups made from composite materials may be anything from 20 per cent. to 60 per cent., according to the predominating material of which it is composed, and this is left to the Customs' officials to determine. All these are restrictions to business, but it is nevertheless gratifying to note that the sales from the British Art Section were considerably larger than those effected in any other foreign section. This, no doubt, was entirely due to the excellence of our

section, and had it not been for the heavy duty a larger number of sales might have been completed. It is to be hoped that the claims of British artists to fair treatment will not be overlooked, if, as is alleged, modifications in the United States tariff are now in contemplation.

With reference to sales, there is something I would like to say with respect to the amounts which some of our artists ask for their works in comparison with those asked by artists competing in the other sections. From my experience gained at several international exhibitions, I cannot help thinking that many of them stand in their own light by fixing prices which are unlikely to encourage purchasers. Foreign artists of the first rank fix the values of their pictures at these exhibitions at prices which more readily command sales. Their failure at St. Louis is quite an exceptional experience for them. Following the example of France, we also withheld our Art Section from competition for awards, and in this decision we had the hearty support of the Arts and Crafts Committee. I may add that other sections of the Royal Commission, notably the Education Section, also withheld their exhibits from competition.

A loss to the British Art Section was the absence of the works of many eminent artists who were prevented from exhibiting with this country by virtue of their American nationality, and many of them sent their works to the American Section. The list includes John S. Sargent, R.A.; E. A. Abbey, R.A.; the late G. H. Boughton, R.A.; J. J. Shannon, A.R.A.; George Wetherbee, R.S.; J. McClure Hamilton; Daniel Wehrschmidt; Mark Fisher; F. Derwent Wood; W. J. Hennessey; and F. D. Millet.

The question is often asked whether these vast international exhibitions can really be successful, and whether the results they achieve are commensurate with the vast expenditure of time and money which they entail, and whether they are even appreciated as they should be. To those who ask whether the St. Louis Exhibition has been successful, I would reply that you cannot gauge the success of any exhibition merely by the amount of money taken at the turnstiles. Its success can only be measured later, if at all. The new reputations made, the number of orders booked, the fresh business opened up, the money brought into the country, and, above all, the new seed that has been sown, and the lessons that have been taught and learnt—all these are factors that have to be taken into account.

There are many reasons why British artists should participate in these international exhibitions, quite apart from the question of the sale of their works. International exhibitions are international competitions. It is a matter of country versus country. The success of any one section adds prestige to the country it represents, and this is why every patriotic Englishman should endeavour to assist in scoring a success at such exhibitions for the honour of his country. Apart from this, the names of artists who elect to be represented are kept alive, whilst those whose names are not to be found in the catalogue, place themselves at a disadvantage in the public recollection and in the record of history.

The impression produced by our section was distinctly favourable, and the Press, both of this country and of the United States, was alike cordial and just in its appreciation of it.

In a still more official manner was our success brought to the notice of the public by the letter of our Ambassador to the United States, Sir Mortimer Durand, who thus wrote to the Foreign Office from Washington on the 18th November:—

"The British Art Section is generally regarded as containing the best collection of pictures in the Exposition."

For this satisfactory result thanks are due to the 135 private owners, societies, and provincial corporations, who came forward and lent their valuable works for the honour of the nation. The co-operation of our artists must be included in our tribute, for their zeal did much to ensure our success.

Our work will have served its purpose if it has raised the prestige of British Art abroad, and helped to encourage our artists at home.

DISCUSSION.

Mr. WALTER CRANE expressed his pleasure at being present to hear Mr. Spielmann's admirable paper, which was practically a personally conducted tour through the Exhibition. The account given from different points of view, financial, artistic, and organisation, was so complete as to make him feel that he might have saved himself the trouble of going to St. Louis. The series of pictures shown gave an admirable idea of the plan and arrangement of the buildings and their general effect, minus the colour, the absence of which one always allowed for in photographs. He

had been particularly struck with the fine way in which the large gallery in the German Room was set up, and thought English artists might take some valuable hints from their German friends in regard to the decorative or scenic effects produced by the arrangement of their galleries. They adhered to the principle, as far as possible, of hanging only one line of pictures, and the eye line was the ideal line from which to inspect pictures. The numerous works in the British Section no doubt made that impossible, but he did not hesitate to say the effect produced was far finer if there was only one line of pictures. The same principle was adopted in the annual exhibitions at Munich, and the arrangement of the colour in the rooms to suit the pictures was far in advance of what was generally thought necessary in this country. Mr. Spielmann seemed to think that the English Section was not altogether advantageously situated in its position in the Arts Gallery. He did not know whether that was due to the usual Govermental action in such matters. England was not usually first in the field, and he believed that Germany and France sent representatives over to St. Louis and secured the best places long before England did; but if the people of this country only decided late in the day to take an important part in the Exhibition, they could not be surprised if the best places had been already allotted. That was too often the case with English authorities, and it was notorious that it was a very hard matter to screw anything out of the Government for the benefit of the representation of the national art in other countries.

Mr. JOSEPH PENNELL said that as the official representative of the St. Louis Exhibition for Art in this country he could confirm Mr. Crane's statement that it was owing to the dilatory action of the English Government that Great Britain lost the best positions, although the place subsequently allotted was not anything like so bad as the author supposed; in fact, it was an excellent position. As to the staircase, the architect forgot the exit at the back of the building was not thirty inches from the ground, as he was given to understand, but thirty feet, which produced an exciting effect, as Mr. Pennell was told many people fell down it though none dared climb it. Mr. Spielmann had stated that England had placed her Art Section *hors concours*. It was impossible for any country to place itself *hors concours*. As a matter of fact, England refused to compete; and he had an official communication in his pocket stating that not only American artists, but the artists of the whole world, extremely regretted that England did not take part in the competition, especially, as in this particular instance, she had sent abroad the best show which had ever been sent out of the country. The British Section was a splendid exhibit for Great Britain, and as popular and as well patronised as any section of any country which exhibited in the Exhibition. The refusal, therefore, to enter the competition for awards—in this Section of the British exhibits only—produced a most unfavourable effect on the international jury.

The CHAIRMAN, in proposing a vote of thanks to the author for his admirable paper, stated that Mr. Spielmann referred to the plodding perseverance and unlimited patience with which the difficulties connected with the Exhibition were overcome. Mr. Spielmann was so modest that he had made no reference to himself in the whole of the paper, but those particular qualities Mr. Spielmann had shown in the most remarkable manner, and the success of the Fine Art Section was due almost entirely to his labours. It was not the first time Mr. Spielmann had acted in connection with international exhibitions, the first time he (the Chairman) had the pleasure of being associated with him was at the Brussels Exhibition, when the English Section for the first time was very prominent. As Mr. Spielmann had stated was the fact at the St. Louis Exhibition, the English Section at the Brussels Exhibition was the only section ready on the day of opening, and the same remark applied to the Paris Exhibition. For that they had to thank almost entirely Mr. Spielmann's wonderful perseverance and patience in carrying out the details. He also ought to state that Mr. Spielmann received absolutely no remuneration for his admirable work as honorary secretary in connection with the Brussels Exhibition, in fact, he was obliged to give up the post he occupied at the time to devote his energies to the purpose. At the Paris Exhibition he accepted the post of secretary, at a very inadequate remuneration; and with regard to the St. Louis Exhibition, he had worked like a Trojan from beginning to end with absolutely no pay or salary of any kind. He therefore thought the thanks of the country were due to Mr. Spielmann for the work he had done on its behalf.

The resolution of thanks having been carried, Mr. Spielmann briefly acknowledged the compliment, and the meeting terminated.

In reply to Mr. Pennell's remarks, Mr. SPIELMANN writes:—The question of competing for awards by artists is one which furnishes sufficient material for a special paper. Something may be said in its favour, but very much, in my opinion, can be said against it. Scientists and artists, literary men, and members of the professions generally, can hardly compete for awards in the same way as manufacturers of machinery or makers of pickles. It must be remembered, too, that our artists are not only invited to compete with foreigners, but amongst themselves, surely not a very dignified proceeding. I believe the majority of artists recognise this, and consider that they ceased to compete for prizes and medals when they left school, and that they no longer attach any importance or value to them. Medals may have an attraction for art students, but artists of

more mature years prefer to abstain than to have to compete for them. Why should eminent artists who have already received the highest honours that the art world can confer be obliged to submit their works to the uncertainties of an unwieldly international jury, the members of which may, for the most part, be ignorant of the artists, and of their achievements? Apart from these considerations, the constitution of the jury and its methods of procedure should determine the question of competition for awards. When either of these are unsatisfactory, or when the rules or regulations are unpublished, it is better to abstain. The composition of international juries is often most unsatisfactory. It may number from 50 to 75 representatives, amongst whom Great Britain may be entitled to, say, three members only. In such a case they would have a hard struggle, if they succeeded at all, in obtaining adequate recognition. Distant countries are frequently represented by jurors appointed on their behalf by the local exhibition officials, and sometimes the jurors so appointed are neither artists nor have any knowledge of Art. There are two methods of awarding medals. When they are unlimited in number they are frequently scrambled for by the jurors in the most unseemly manner, quite apart from the question of merit. When the number is restricted it is equally unsatisfactory. The jurors may determine to apportion to Great Britain, say, twelve gold medals and twenty-four silver medals. In a collection of high average excellence this is particularly unfair. Instead of twelve pictures of the highest merit there may be twenty. To say that twelve of them should have gold medals, and the remaining eight of equal merit nothing at all, solely because there are no more medals to have, is manifestly absurd. Under such conditions it is better and more dignified to withhold the entire Art Section from competition. These remarks do not refer in any way to St. Louis, but to the methods adopted at international exhibitions generally, and apply specially to the Art Section.

THE PROGRESS OF ORTHOCHROMATIC PHOTOGRAPHY.*

Dr. Koenig, whose name will be readily recognised as the discoverer of the isocyanine dyes, which are now so much to the fore, contributes a useful article to the *Deutscher Camera-Almanach*, of which the following is an extract.

Every photographer and amateur, who knows anything at all of photography, understands what is meant by orthochromatic photography and orthochromatic plates, but it is not every one that rightly understands the subject, for some use orthochromatic plates and a yellow screen, while others see no advantage in the same. The real truth lies probably between the two, and it is only actual experience that enables one to appreciate the practical results of this scientific advance.

It is well known that, notwithstanding the correctness of the drawing and perspective given by photography, it has two great faults, the one the exaggerated difference between light and shade, and the other that it does not render colours in the same gradation or brightness as seen by the human eye. This false rendering of colour is particularly noticeable with yellows, or bright reds and blues; to our eyes yellows and red appear bright, and blues dark; by photography blue is rendered very light and yellow and red quite dark, because the gelatino-bromide is only sensitive to blue and violet and not for red, yellow, and green.

The Discovery of Orthochromatism.—In 1873, H. W. Vogel discovered that many dyes possessed the property of making silver bromide sensitive to red, yellow, and green, or, as is usually called, "sensitised" for these rays. The first observation was made with collodio-bromide of silver, but other experimenters soon proved that gelatino-bromide of silver behaved in the same way, and now a very large number of dyes are known which sensitise gelatino-bromide of silver for the different regions of the spectrum. All these dyes also stain silver bromide direct, in the absence of gelatine, but it is a remarkable fact that not all dyes which stain silver bromide also sensitise. Whilst it has not yet been satisfactorily explained why only certain dyes possess sensitising properties, yet there is a certain connection between the absorption spectrum of the dye and the band of sensitiveness. The maximum of the sensitising lies at about the same place as the maximum absorption band of the dye solution; thus generally sensitisers for green and greenish yellow are red, and sensitisers for yellow and red are violet or blue.

The most important sensitisers for green and yellow belong to the phthaleins, the best sensitisers for red are the cyanines. To the first-class belong eosine (tetrabromofluorescine), di-iodofluorescine, and erythrosine (tetraiodofluorescine). The maximum of sensitising lies with eosine in the green, and does not reach the Fraunhofer line D; with erythrosine the sensitiveness extends to beyond D; di-iodo-fluorescine lies between the two. Erythrosine must be considered as the strongest and best sensitiser for practical work.

The various dyes may be used in one of two ways: they may be either added to the emulsion before coating or ordinary dry plates may be bathed in very dilute solutions of the dye. The amount of dye to be used must be very minute, too much dye lowers considerably the general sensitiveness of the plate, as the deeply-dyed film prevents the penetration of the light. With all dyes the best results are obtained by bathing the plates.

The Yellow Screen.—If a colour chart is photographed with an erythrosine-bathed plate chrome yellow will appear almost as bright as ultramarine; red, on the other hand, appears absolutely black. If

* From the *British Journal of Photography*.

it is desired to drive the orthochromatic action further, and to render yellow considerably brighter than blue, a yellow colour filter must be used, which damps the blue. The action of the colour screen does not seem to be thoroughly understood. If we realise that the so-called orthochromatic plates are always pre-eminently sensitive to blue, and that while on account of the proportion of blue rays in it must always exert the strongest photographic action, we shall easily understand that by the insertion of a yellow screen, which partially absorbs the blue rays, the exposure must be prolonged in order to obtain the same density in the whites. If two exposures are made on orthochromatic plates, one without a filter, the other with a bright yellow filter, and the second exposure twice as long, so that white has equal density in both, the blues will appear much weaker on the second plate than on the first; yellow, on the other hand, will appear much the stronger on the second than the first. By the increased exposure the yellow rays, which are not absorbed by the yellow screen, have acted more strongly on the yellow sensitive film.

It is obvious, therefore, without further explanation, that a plate which is only slightly sensitive for yellow requires a darker yellow screen (and therefore a longer exposure) for correct colour rendering than a plate which is strongly sensitive to yellow.

Commercially, as a rule, plates sensitive to greenish yellow, and which are usually sensitised with erythrosine, are called "orthochromatic," although they are not sensitive to red. Most of these plates only give a satisfactory orthochromatic action with a dark yellow screen. The idea has been adopted for some plates of placing the yellow screen in the sensitive film, and the plates thus prepared permit of good colour rendering without a yellow screen.

The Cyanines.—We have mentioned above the second group of sensitisers—the cyanines. To this class belongs cyanine, a beautiful blue dye, which is an excellent sensitiser for yellow, orange, and red. Unfortunately this dye does not give reliable results, as the plates sensitised with it does not keep, and are prone to spots and fog. More important and more valuable from a practical point of view are the violet isocyanines, which are derived from chinaldin, because they not only possess the property of sensitising silver bromide for red, orange, and yellow, but make it also sensitive to green. The isocyanines combine therefore to some extent the properties of erythrosine with those of cyanine. With ethyl red, which was introduced by Professor Miethe, the nearly complete band of sensitiveness extends from the blue to the orange to just beyond the D line, the band of orthochrome T extends further into the red, and that of pinachrome extends even, with a short exposure, to beyond the C line in the red. Practically this means that plates sensitised with pinachrome are much more sensitive to orange and red than orthochrome plates, and more so still than ethyl red plates. Pinachrome must be considered as the best sensitiser known up to the present.

With these dyes the bathed plates are considerably more sensitive to colour than those coated with dyed emulsion.

With the aid of the said isocyanines or of mixture of dyes which supplement their sensitising properties, plates can be prepared which are sensitive to all the colours of the spectrum, even if not to quite the same degree. These "panchromatic" plates have also their maximum sensitiveness in the blue. The principal use of such plates is for colour photography, but their use is absolutely indispensable when orange and red have to be reproduced; for such work the inter-position of an orange filter, to damp the blue and green, is always essential. It may be mentioned that up to the present no plate exists which is even approximately as sensitive for red as for blue.

The Use of Orthochromatic Plates.—Very different opinions as to the use of orthocromatic plates are held generally. Undoubtedly ortho-plates in conjunction with a colour filter are useful in innumerable cases, and frequently absolutely essential. It does not appear, however, correct to the author to recommend the universal use of ortho-plates for all landscape, and especially for mountain work, for it makes the photographer think that it is actually possible to take ordinary landscapes with an ordinary plate. When yellow and yellowish-green tones predominate, as in autumn or spring, or evening scenes, the ortho-plate can always be used with advantage, and in portraiture their use saves much retouching. Ortho-plates are absolutely essential in the reproduction of all coloured objects. The frequently-described great advantages of the orthochromatic process in the taking of summer-green landscapes, of mountain peaks and distance, the author denies, although he is convinced that this heretical opinion will be frequently disputed.

As regards landscapes in summer, we ought not to forget that every kind of plate is very little sensitive to the dark green of summer leaves, and further that in a bright light, and much more in sunshine, it is the white light reflected from the leaves much more than the green that produces the photographic image. As a matter of fact, the author has never succeeded in confirming a difference between orthochromatic and ordinary plates for ordinary landscape work.

It is just the same with mountains and distant scenery; with these the yellow screen and ortho-plates should work wonders. The author certainly believes that many amateurs obtain better results with the aid of these two, but the pictures are only better because the true exposure is mostly involuntarily rendered shorter by the yellow screen, or, what comes to the same thing, the ortho-plates are frequently less sensitive than the ordinary. If the ordinary plate is only exposed for a sufficiently short time the cloudless blue sky will also appear darker in the print than the snow peaks glistening in the sun; and if the sky during the exposure is whitish, so that the mountain is visually almost impossible to detect, then no orthochromatic plate and no yellow screen is of any avail to obtain a difference.

It may be argued that the use of orthochromatic plates can at least do no harm. Opposed to this are the facts that ortho-plates are mostly dearer than ordinary, and frequently are inferior as regards keeping properties and sensitiveness, though, as we have already seen, this last may be an advantage under certain conditions. Finally, the exposure is considerably lengthened by the yellow screen which must generally be used.

The photographer will do well to consider in every case whether the use of ortho-plates appears advantageous or not. As a guide to this point a few short rules may be useful, which embody what we have said.

When to Use Ortho-Plates.—1. According to the prevailing method of speaking we differentiate between orthochromatic and panchromatic plates. The former are only sensitive for yellow and yellow-green; the latter are also sensitive to orange and red.

2. The commercial orthochromatic plates only permit of an absolutely correct colour rendering, as regards yellow and blue, when used with a yellow screen of more or less dark shade.

3. The use of orthochromatic plates is above all things necessary when the reproduction of yellow and yellow-green is in question. For bluish green and dark green the plates, even with a yellow screen, are very slightly sensitive, so that for ordinary landscape work, further for mountain and distant scenery, the ortho-plates offer no important advantages.

4. Panchromatic plates are certainly necessary when orange and red are to be reproduced, and in this case the use of colour filters is absolutely essential.

5. Bathed plates are always more sensitive than plates dyed in the emulsion.

Formulæ for Bathing.—Always use perfectly clean working plates, and bathe them in the dark, keeping the solution continuously on the rock After bathing, the plates should be washed in running or frequently changed water for two or three minutes, and dried in a well-ventilated place free from dust.

Erythrosine Bath.

Water	100 ccm
Ammonia	2 ccm.
Erythrosine solution (1 : 1,000)	6-8 ccm.

Bathe for 2-3 minutes.

Pinachrome Bath.

Water	100 ccm.
Ammonia	1 ccm.
Pinachrome solution (1 : 1,000 alcohol)	2 ccm.

Bathe for 3-4 minutes.

Ethyl red and orthochrome plates are prepared in exactly the same way as the pinachrome plates.

GENERAL NOTES.

UNITED STATES RAILWAY SPEEDS.—Reporting on the railways of the United States (No. 627, Miscellaneous Series), the Hon. Robert Collier says that, "with certain exceptions," they are "not particularly fast." But the exceptions are noteworthy. The best speeds appear to be found between Philadelphia and the sea-side resorts of Atlantic City and Cape May, where in summer there are a certain number of very fast trains. From Atlantic City to Camden (a suburb of Philadelphia) *viâ* the Philadelphia and Reading line, one train last summer was for a time given only 49 minutes, start to stop, for the 55½ miles, while between Camden and Cape May, on the Pennsylvanian Railway, there is a train which covers the 72·2 miles from Camden to Angelsea Junction in 73 minutes, start to stop. On the New York Central route, between New York and Chicago, the "20th Century Limited," covers the whole 980 miles in 20 hours in either direction. There are a considerable number of trains making start to stop runs at over 50 miles an hour, and the "Empire State Express" even performs two runs at 57 miles an hour. Further west the trains get slower and less frequent. While electricity is almost exclusively used as the motive power of the very numerous tramways in every part of the country, on railways it is used to a very limited extent only. The overhead workings of New York and Chicago are the most conspicuous instances. For working trains through tunnels where the traffic is intense, and for tubular work in general it is probable that electricity will be more and more used as the motive power, but the prospect of anything like a revolution in the direction of its being employed to work long distance railway traffic seems remote.

IRELAND AND POTATOES.—With a steadily dwindling population it is not surprising that the area under potatoes in Ireland is much smaller than it used to be, but they remain the staple crop, and the "Champion" variety continues to be the m st popular. In 1883 the total area under potatoes was 806,467 acres, in 1904 it had fallen to 618,540 acres, a decrease of over 23 per cent. In 1883 the proportion of the entire crop under "Champion" was 78·5, in 1904 it had fallen to 61·3; so that even now only 38·7 per cent. of the area under the potato crop is left for all other varieties. The "Champion" potato was first introduced in quantity into Ireland in the year 1880, after the failure of the potato crop in 1879. Since that year it has constituted the main potato crop of the country, but, as shown above, it is gradually losing its hold upon the cultivator. The acreage under each of the principal varieties of potatoes planted in 1904, other than the "Champion," was as follows:—Up-to-date 9·6 per cent., Beauty of Bute 7·0, Flounders 6·8, Sutton's Abundance 4·5, Irish Whites 3·0, Skerry Blues 2·9.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

MARCH 8.—"Ethics of Japanese Society." By BARON SUYEMATSU. The RIGHT HON. LORD REDESDALE will preside.

MARCH 15.—"Methods of Design in Mohammedan Art." By E. H. HANKIN. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock :—

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

DUGALD CLERK, M.Inst.C.E., "Internal Combustion Engines." Four Lectures.

LECTURE IV.—MARCH 6.—*Future Developments*—Suction producers—Blast furnace gas—Producer gas in power-stations—Marine gas and oil engines—Line of advance.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Dugald Clerk, "Internal Combustion Engines." (Lecture IV.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Benjamin H. Thwaite, "The Transport possibilities of our Inland Navigable Waterways."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Prof. H. E. Armstrong, "Mechanics of Fire." 2. Dr. George McGowan, and Mr. R. B. Floris, "The Estimation of Arsenic Fuels—A shortened method."

Faraday Society, 92, Victoria-street, S.W., 8½ p.m. Mr. F. W. Harbord, "Recent Developments in Electric Smelting in Connection with Iron and Steel."

British Architects, 9, Conduit-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 5 p.m. Annual Meeting.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. Charles B. Warring, "Geological Exterminations."

TUESDAY, MARCH 7...Royal Institution, Albemarle-street, W., 5 p.m. Prof. Pearson, "Some Recent Biometric Studies." (Lecture II.)

Alpine Club, 23, Savile-row, W., 8½ p.m. Lecture by Captain Scott.

Designers, R.I.B.A. Galleries, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. Strange, "Ornament for Old English Rood Screens."

Civil Engineers, 25, Great George-street, S.W., Discussion on Mr. Richard William Allen's paper, "Surface-Condensing Plants, and the Value of the Vacuum Produced."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, MARCH 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Baron Suyematsu, "Ethics of Japanese Society."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m.

Japan Society, 20, Hanover-square, W., 8½ p.m. Prof. J. H. Longford, "England's Record in Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m. Annual Meeting.

THURSDAY, MARCH 9...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. H. H. Turner, "Recent Astronomical Progress." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Report on Experiments carried out at the National Physical Laboratory. 2. Dr. R. T. Glazebrook, "The effect of Heat on the Electrical and Mechanical Properties of Dielectrics," and 3, "The Temperature Distribution in the Interior of Field Coils." 4. Mr. R. Goldschmidt, "Temperature Curves and the Rating of Electrical Machinery."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 10...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Professor J. J. Thomson, "The Structure of the Atom."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. F. G. Helsby, "The Purification of Sewage." 2. Mr. F. O. Kirby, "The Purification of Sewage by Hydrolysis and Oxidation."

Astronomical, Burlington-house, W., 8 p.m.

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Mr. H. V. Lancaster, "Law Courts."

Clinical, 20, Hanover-square, W., 8½ p.m.

Royal College of Science, Exhibition-road, South Kensington, S.W., 8 p.m. Dr. C. Chree, "The Stresses in the Earth's Crust before and after the sinking of a Bore-hole." 2. Mr. J. Morrow, "The Lateral Vibration of Bars of Uniform and Varying Sectional Area." 3. Mr. A. Campbell, "Direct Reading Resistance-Thermometers, with an Appendix on Composite Thermocouples."

SATURDAY, MARCH 11...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Electrical Properties of Radio Active Substances." (Lecture I.)

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FRIDAY, MARCH 10, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 13, 8 p.m. (Cantor Lecture.) HERBERT LAWS WEBB, "Telephony," Lecture I.

WEDNESDAY, MARCH 15, 8 p.m. (Ordinary Meeting.) E. H. HANKIN, "Methods of Design in Mohammedan Art."

THURSDAY, MARCH 16, 4.30 p.m. (Indian Section.) T. C. HODSON, "Manipur and its Tribes."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, March 6, Mr. DUGALD CLERK, M.Inst.C.E., delivered the fourth and last lecture of his course on "Internal Combustion Engines."

The CHAIRMAN (Professor W. G. Adams, F.R.S.) proposed a vote of thanks to the lecturer for his interesting and important course of lectures, which was carried unanimously.

The lectures will be published in the *Journal* during the summer recess.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, February 21st; JOHN BELCHER, A.R.A., Pres.R.I.B.A., in the chair.

The paper read was—

THE QUEEN VICTORIA MEMORIAL AS COMPARED WITH OTHER ROYAL MEMORIALS ABROAD.

By MARION H. SPIELMANN, F.S.A.

On the morrow of the death of Queen Victoria, it was the universal feeling that some monument, some visible memorial of her greatness and her goodness, and of the enduring love and respect of her mourning subjects, should be set up here in the metropolis of her Empire.

If ever sovereign could say, in the words of Horace, *Exegi monumentum ære perennius*—"I have reared a memorial of myself more enduring than bronze"—that sovereign, we knew, was Queen Victoria; but it was not solely for her honour, but for our own satisfaction and delight, that the propriety, the exigency, of such a memorial forced itself upon us as a duty and a pride. It is, of course, true that those who deserve a statue do not need one; but the memorial is the consolation of the survivors, and, if rightly conceived, is as noble a tribute to their own unselfish gratitude as it is to the glory and greatness of the man or woman whom we design to honour.

If this much is conceded, is it not a severe commentary on, a tacit condemnation of, the utilitarian habit among us, which so often seeks to make capital out of the loss of some great sovereign or statesman or philanthropist, and to turn the kindly emotions of the public into cash for the purpose of some public work

or charitable institution? These are most excellent undertakings, of course, deserving of all our enthusiasm; but surely it is not quite worthy to make use of the passing of the dead for the best concrete advantage of the living. If a hospital wing, or a soup kitchen, or national theatre, or public library, or village clock are needed, they may be erected by the public-spirited and the charitable without the pretence of seizing on the memory of a great and famous one just dead and feeding our needs on that. I am told that when the Prince Consort died, a small southern county town, in bad sanitary condition, actually evolved the idea of a public subscription for what was to be called an "Albert Memorial Sewer." Could anything be more revolting? And yet is there one of us here present who, after the death of Queen Victoria, did not receive many such appeals as I have mentioned, for the maintenance of worthy institutions, or the restoration of churches, hospitals, and the like? If it is answered that this use of the lever is the only way of getting things done, and it must be done, let it be openly recognised, without any of the evasion which Molière's "Alceste" would have openly called hypocrisy, that these works are not so much for the glory of the departed as for the better use of man, and that the practical spirit of affairs has been allowed to overlay the more generous and unselfish sentiments involved in a public statue or kindred national memorial.

It was, therefore, a happy inspiration that directed the form of the Queen Victoria Memorial—a great work, and a monument not devoted to the interests of any particular section of the public, but open to the enjoyment of the whole world who chose to come and gaze and remember; a work whose only use is beauty, and only purpose glorification—not only for our present satisfaction, but for a symbol to future centuries, when our hospital buildings, our soup kitchens, and our clocks of to-day, will be torn down and cast aside.

A heavy responsibility lay upon the distinguished committee appointed to determine the exact form the memorial was to take, but there was a general confidence that the demands and requirements would be fully appreciated. Examples abounded; examples that might be followed, and examples that must be shunned. For there exist—as I shall presently show—a few noble monuments to great rulers departed, and many failures—monstrous, effete, ridiculous, vulgar, in turn—which seem to have served less to warn the public against the false in sentiment and the bad in art, than to accustom and reconcile them to the sight of what is poor, pompous, and meretricious. It is for this reason that the nation expects that the memorial to Queen Victoria shall be the finest expression of national feeling and of national art to which the race can give utterance. The case, it is felt, demands the combination of forces of the best of our sculptors and architects available, who are at once artists in imagination and execution. As for the sculptor, on whoever the choice might fall, he was to be a man capable of understanding two things. He must appreciate beauty and dignity in sculpture in their highest and noblest form, and recognise the border-line that exists between the dramatic and the truly sculpturesque in plastic art, or the result, it was felt, would certainly be a failure; and he must feel, and so be able to appreciate and translate, the double sentiment to be expressed in this monument—the true greatness of the Queen, and the sentiments of her people.

The committee consisted of:—Viscount Esher, Lord Windsor, Lord Redesdale, Sir Edward Poynter, Sir William Emerson, Sir Lawrence Alma Tadema, Mr. Sydney Colvin, and General Sir Arthur Ellis—a committee which commanded the confidence alike of artists and public.

Seeing, then, the necessity of appointing a sculptor, rather than opening a competition from which probably most leading sculptors would on principle hold aloof, the committee placed the commission outright in the hands of Mr. Thomas Brock, R.A.—to whose record I shall have to refer in a few moments—and they decided on opening a limited competition of five selected architects. On the winner would fall the duty of laying out the whole ground from end to end, and providing the architectural setting. They, therefore, determined on the names of three eminent architects in England, each widely renowned: Mr. T. G. Jackson, R.A., Mr. Ernest George, and Sir Aston Webb, R.A., all three of England—Londoners, in fact—Sir Rowand Anderson, representing Scotland, and Sir Thomas Drew, President of the Royal Hibernian Academy, representing Ireland.

Before we proceed to examine the designs for the memorial, it will be useful and interesting to see what has been done in somewhat similar cases by foreign countries and peoples. In this way, we here shall be equipped, according to our powers, to form a sound

opinion on the subject, and to judge how far—and, I may add, how admirably—this English scheme may compare with what has been done elsewhere, by the greatest artists of their day, by the most glory-loving and art-loving nations of Europe.

I take Russia first, and choose as the earliest of the modern royal and national memorials to put before you the colossal equestrian statue of Peter the Great in St. Petersburg.

It is not a Russian production, although made in Russia; it is the work of Falconnet—all but the head of the Emperor, which is by his daughter-in-law. The curiosity, the marvel, about it is, that although it weighed 16 tons, the statue is said to have been originally cast in one piece; and the balance of the rearing horse, supported on his hind legs and tail (which contains 10,000 lbs of metal) was wonderfully calculated. The pedestal consists of a block of granite weighing 1,500 tons, which was cleverly rolled from a neighbouring village to the spot on cannon-balls along an iron tramway. It was set up, you will recollect, by the Empress Catherine II., to the masterfulness of her great predecessor, in 1772, after taking 12 years to complete.

The column erected in 1832 by "grateful Russia" to the memory of Alexander the First derives it chief renown from being a monolith, and the greatest of modern times. The shaft weighs 400 tons. In one piece (as I have said), it is of red granite, 84 feet high, cut down from its original measurement of 102 feet, as it was feared that that enormous length was too dangerously great for its diameter of 14 feet. The whole, with the figure of the angel on the top, is 155 feet high, erected on its base—equally of one piece, and of red granite, 25 feet high. It also is the work of a Frenchman—of the architect, M. de Montferrand (the designer of St. Isaac's Cathedral), and was polished after it was set up. This rather foolish work cost not less than £400,000.

I say "foolish" because, for my part, I never could appreciate the idea of a mere column to the memory of any man, even if it has the virtue of being in one piece, and even if—especially if—it is crowned by a statue of the gentleman chiefly concerned; unless, of course, it is intended as a landmark, as is the case with the Napoleon Column at Boulogne. The figure cannot be seen. The shaft is an elongated cylinder—a poor shape when unsupported by others or by architectural forms; an opinion I venture to assert in the face of such precedents as Trajan's Column in Rome, the Vendôme Column in Paris, and the Duke of York's Column in London, where the figure is raised far above the chimney-pots and beyond recognition, with a lightning conductor through its brain! There is little or no invention, no play for artistic design, in such a device, in spite of a well-designed base. It is merely a stone pole, which perhaps to the popular mind is its chief attraction; for it gives no opportunity for thought or fancy in the designer, and consequently throws no strain upon the intelligence, or upon the artistic emotions of the man-in-the-street, or even the man in the town council.

The monument of Nicholas I. was erected in 1839. Seen from a distance, the rearing horse seems poor enough beside the fine massive proportions of the base, an enormous pedestal composed of granite of various colours.

Viewed nearer still, the proportions of the horse do not improve, and there is something to criticise on the score of taste in the details of the whole. The bas reliefs represent the chief episodes in the life of the Tsar, with four emblematical figures around the upper portion of the base, which are portraits of his wife and three daughters. Although the great lamp-posts interfere somewhat with the view, they add not a little richness to the whole.

The monument of the Empress Catherine II. was carried out by two Russian sculptors, Mikeshin and Opekushin, but the work was cast by an English firm in St. Petersburg—Mr. Baird's.

Set up in the Nevski Prospect, in front of the Alexander Theatre, it looks well when seen close; but at a distance its compactness tells against it, and the figure and the poor architectural base, with too little variety of outline and silhouette, tend to merge into a form like a hand-bell. Nine figures in high relief of Catherine's chief supporters in her government and reform are arranged in sitting posture around the pedestal. The female figure on the left is that of Princess Woronzoff Daschkoff, the first president of the Academy of Arts of St. Petersburg. Forty-nine feet is the height of the monument, which was unveiled with great ceremony in 1873.

Austria is not behind in the matter of royal monuments. The most important is that of the Empress Maria Theresa—an elaborate composition, in which the architecture and sculpture are well balanced—erected in front

of the Imperial Palace, and between the great twin museums built by Hasenauer, the architect who designed this pedestal. The sculptural portion is by von Zumbusch. The dominating figure of the Empress, in bronze, 19 feet high, is enthroned on the marble pedestal, 43 feet high. She salutes her people, and holds in her hand the Sceptre and Pragmatic Sanction —the symbol of unity of the Austrian Empire.

One of the defects of this imposing composition seems to me to be the variety of scales on which the various figures are designed. The ideal personifications of Strength, Wisdom, Justice, and Mercy, at the feet of the Empress, although life-size, look like dolls in comparison; and the equestrian figures, the isolated figures, and those in high relief, cleverly as they are arranged, tend by their different sizes to confuse the eye. This is a difficulty which Mr. Brock has successfully overcome. I show this enlargement in order to demonstrate the mistake of placing fully detached figures against a low relief in which they are in direct relation. Here we have a group of Eckhel, the numismatist, the historian Georg Pray, and Glück and Haydn—the former holding the child Mozart's hand—and, as we see, the shadow thrown by Glück's head upon the distant building helps to destroy the balance of the composition and confuse the whole. This work dates only from 1888, when it was set up by the Emperor Francis Joseph as a centenary celebration. It occupied altogether over 14 years, and cost £72,500. From these works, conceived in the conventional spirit, let us turn to more recent memorials in France, raised, in this case, not to a sovereign, but to modern statesmen, eminent and patriotic.

The monument to Gambetta in Paris is interesting to us for more than one reason. Raised to a great statesman, and so, I fear, not quite legitimately introduced here, it is a capital type of the silhouette much affected by French sculptors, and by other nations who follow them. This photograph is unfortunately disfigured in its *ensemble* by the wreaths, and by those very inartistic objects in street photography, men and women, appearing here in honour of the anniversary of the patriot's death; but it will serve. The statue of Gambetta illustrates conclusively enough the denunciation of the frock-coat in sculpture so amusingly set forth by that admirable critic, M. de la Sizeranne. The garment does not lend itself to poetry, whether in words or stone. The modern coat does not cover only, but masks and conceals the body, the beauty of which it ought to suggest, not only the forms but movements. Movements of the figure, the action of the wind, or action by the body, are all alike stultified by a coat, held by buttons which prevent not only proper play of the figure, but also of the natural folds which should follow every movement—that is to say, all the material for beauty in a human body and its action. Compare the fine action of a man—as of a Spanish or Italian peasant—throwing his cloak around him, with the ridiculous antics of one of us wriggling into his coat, and judge whether the illogical covering is not monstrous, artificial, unadaptable to the body, cylindrical in aim; in every particular opposed to the figure it clothes. And to ask a sculptor to represent the human form, clothed impeccably and photographically in its coat of to-day—to be, in fact, a tailor in stone—would be like expecting Ruskin to write his fine oratorical and poetic passages in the terms and with the flags of the signal-book.

It will be conceded that it is somewhat in this spirit that the modern sculptor has to deal with the frock-coat, if he is to deal with it satisfactorily and interestingly. We see here to what lengths the sculptor has gone to get variety; he has put his subject into a gale of wind. This lack of repose in the marble group, however, is partly intended to typify the fury of events, and the tempestuous career which form the background in which Gambetta's life is set.

The taste may appear to some a little strained in its details, but the effect is very fine, nevertheless, especially by the power given by the two bronze flanking figures, "Strength" on the left and "Truth" on the right; a form of composition, "elbowing-out," as it were, at the sides, giving power and grace, which we shall presently see again. The pyramid—a form on which Mr. Brock has determined for the Queen Victoria Memorial, though with greater restraint—is here somewhat emphasised; it is surmounted by the bronze figure of "Democracy"—a maiden representing the Republic, seated on the winged lion. Of this fine monument in stone and bronze, admirable in its architectural treatment, M. Aubé was the sculptor, and M. Boileau, the architect.

In the great memorial set up to the honour of President Carnot, by Henri Gauquié, the sculptor, and M. Naudin, architect, and recently unveiled, afer four years' preparation, in Lyons—the city in which he was assassinated —we have a design belonging to the class of

which the Gambetta in Paris is perhaps the most important example. This is weaker and more attenuated in design, and yet, being more complex in its lines, it is still somewhat imposing in its way. Side figures are again used to impart an air of strength and stability to the whole, and the parts are well imagined. The effort to get away from the tyranny of the coat, so characteristic of the modern French sculptor, is apparent here as in the Gambetta memorial; yet even the freely-treated overcoat has to be thrown back in order to afford a glimpse of the evening dress-coat underneath, or how would a Frenchman recognise a President? It cost only £10,000, of which £6,000 went to the architect and £4,000 to the sculptor.

Spain is hovering, hesitating, between the past and the present, and a very poor present, too. As an example, you have this, the latest effort of Spanish genius.

Perhaps I ought to apologise for putting it before you. It is the prodigious model for the memorial to King Alfonzo XII., now in course of execution and erection, by Senor Quérol, who is generally considered to be now the leading artistic figure in Spain, and is really an able man. But with this riotous spirit we can have no sympathy; there is here nothing of the dignity of sculpture, or of the repose of the death monument, which, however glorious, however turbulent, may have been the life and reign of the monarch it honours, though it represent the splendour, must always avoid the mere fuss of life. But why all this clang of glory? Was King Alfonzo—whose memory we all respect—so mighty a conqueror? We have a sculptural *tour de force*, in parts lamentably skilful, hopelessly unimpressive; a debased taste which we deplore when we recognise it in "Vienna goods" or "Articles de Paris," or even in wedding-cakes. This exuberant production would have been a constant regret and eyesore to every Spaniard who can still appreciate the dignity and true nobility of Velasquez and Spain; but I have recently ascertained that the cloud of horsemen mounting into the pedestal has been cleared away, and the low semi-circular screen has been enlarged and elaborated in imitation of Sir Aston Webb's by the clever architect, Señor Don José Riera.

Turning to Belgium, we come to her principal modern memorial monument, which has been erected in Laeken, to the north of Brussels. It belongs to the canopied series, and set up, as it is, on the summit of eminence 200 feet high—the Montagne de Tonnerre, it shows a somewhat better proportion perhaps than appears on the screen. This highly-decorated but ill-designed Gothic structure, which, to undiscerning eyes, may recall the spires of Cologne, is dedicated to King Leopold the First, the consolidator of the Belgian monarchy, a statue of whom, by Geefs, stands in the interior. The architect was M. de Curte. The pierced work, surmounted on the apex by a statue of St. Michael, imparts a lightness to what might otherwise have suggested the heaviness of an extinguisher; but yet we cannot be quite strangers to Ruskin's feelings, when he scoffed at Gothic church steeples set upon the ground.

Germany has a number of important monuments, and the most recent crop, if not exactly fine, is plentiful.

The first, and to my mind, still the finest of any, is the statue in Unter den Linden to the Emperor Frederick the Great, whose memory had to wait until 1851 for this act of tardy justice. Then Rauch was commissioned to execute this great bronze monument which is so original in idea, so excellent in effect, so good in light and shade, and so fine in its technical details of texture and finish.

"It is impossible," it has been said, "to realise, with such means, a more imposing work." When it was begun this monument was never intended to be so large and important—Rauch's sketch models prove that, and show how he modified and developed his first conception into what we now see. The statue itself (17 feet high) boldly endowed with the monarch's own peculiarity of dress—(the queue to the hair and the walking stick dangling from his hand) is a striking effigy. And the general arrangement of the granite pedestal, 25 feet high, is simple in its mass and excellent in design.

The great bronze groups represent, with the utmost fidelity to fact and likeness, the commanders during the Seven Years' War, in number thirty-one. There is, of course, a variety of scale here, too, in the figures, but it does not force itself upon the eye.

The equestrian figures (comprising Duke Ferdinand of Brunswick; Prince Heinrich of Prussia; General Seydlitz; and General Ziethen) are very cleverly introduced; the hinder quarters of each animal are cast in high relief—and the fore parts entirely detached in the round. This is a device which Rauch had previously adopted in his severely pseudo-classic statue of Maximilian

Joseph I. at Munich, where the four lions had been similarly treated by him in 1835—sixteen years before.

Up on the slopes of the Rhine, in the Niederwald, opposite Bingen, on the spur of a hill 740 feet high, stands the great national monument commemorating the founding of the German Empire in 1870 and 1871. It was designed by Professor Schilling of Dresden, and approved in 1877. It was inaugurated by the Emperor William I. in 1883. The architectural base is 78 feet high—roughly, about the extreme measurement of Mr. Brock's memorial from the ground to the tip of the Victory's wing. The enormous figure of Germania, symbolising the unity and strength of the Empire—is 33 feet high. The Eagle of Empire is a leading feature of the base, which is flanked by figures of Peace and War, between which is a great panel in high relief, containing portraits of King William of Prussia, mounted, and the other princes and generals; and below, are the figures emblematic of the Rhine and the Moselle. The monument cost £55,000, and occupied six years in execution. The vast proportions and heavy mass and outline of this noble work are adopted partly with a view to effect, as a great landmark in the surrounding country; an effect which is successfully secured.

A less impressive work is the Prince Bismarck Monument, which stands before the Reichstag Buildings. It is by Herr Reinhold Begas, the sculptor who for so long has had the special favour of his Sovereign, and who is held to be partly responsible for the Sieges Allee—the Avenue of Victory—which is the joy of Berlin, the joy of admiration in one half, and of scoffing criticism in the other. For although this continuous pæan of triumph is natural enough, the glory being great, it is thought by some that all this fanfare is apt to be a little too flamboyant.

The figure of Bismarck stands 6½ metres high—the scale wisely adopted for all the other figures—which seem to be so strangely detached from the principal feature. It will be observed how here, also, the sculptor has wrestled with the uniform, and how by dropping down the upper corner of the coat, unbuttoned, and by casting the skirt into horizontal folds by the drag of the sword-hilt, he seeks to modify the distressing inaction of the formless and unsympathetic garment. In front is Atlas, typifying the bearing by Bismarck of his own world, and some other peoples', upon his shoulders. To the left the sibyl, with her book, symbolises wisdom, and the helmeted maid on the right, statesmanship.

The back shows the figure of Siegfried, the all-conquering knight and craftsman, at work on his sword—a sort of early Nibelungen Bismarck. The sculptor, as on other occasions, has deliberately offended against, or, at least, departed from, what is sculpturally legitimate by making his figure get off the pedestal, and stand, as it were, among the public. He had done this before in his great fountains—the Schloss-brunnen in Berlin—and so has shocked the purists past all imagining. Whether the effect he has secured by this strange overhanging is worth the sacrifice is a serious question.

The sculptor, with his helpers, completed this memorial, after only four years' work, in the 70th year of his life.

Similarly, in the case of the statue of the Kaiser William the Great, in Berlin, utter failure attended the first competition, which, in 1888, attracted not fewer than 147 sculptors. At the limited competition which followed, the Emperor signified his preference of the work of Begas, who received the commission at the end of 1892. In Supply £400,000 was proposed in 1894, but the amount was cut down to £200,000; and as the unveiling was to be a centenary celebration the sculptor was ordered to proceed and to get the work done by 1897—by which date the Bismarck monument was awaiting him to execute. Feverish activity reigned in his studio. An army of clever young sculptors and students were at work under the master, on the details, and Begas centred his attention on the equestrian group of the mounted Emperor, whose horse, his favourite charger, "Hippocrates," is being led by "Peace"—of all people!

The statue is 29 feet high, or about 13 feet higher than Rauch's Frederick the Great. At the sides are the figures of "War" and "Peace," independently sprawling out of the composition down the steps, a trick—or perhaps I should say, an artifice—which is greatly affected by Begas. A closer view is instructive.

At each corner are "Victories" on globes, with flowers and wreaths. Projecting from the base are threatening, snarling lions—which the figure of "Peace" above cannot render reassuring—uncomfortably astride of bundles of banners and tattered flags, bayonets, gun-carriage wheels, cuirasses, helmets, cannon,

and shells in bristling confusion; and the emblems of the Imperial sovereignty trickle, as it were, down the front steps.

The colonnade behind is 260 feet long, and it is to be remarked, that of the series of important memorials we have seen, this is the first—and, with the exception of another to follow, the only—important work (besides the recent statue of the Empress Augusta) that is thus supported by architectural embellishment.

This monument, therefore, has importance for us; and in view of our great work that is to come, we are bound to criticise it. For we cannot but consider it spotty in light and shade—baroque in style—even fussy; as if it wanted some good, serious sculptor of refined taste and artistic restraint, to come and tidy it up. It has been described by a German critic as a "Siegeshymnus"—a "Hymn of Triumph." But it does not sing. It seems, in spite of its great qualities, to shout glory, if in rather a sugary voice—not in the simple notes of modest thankfulness, but rather in a "trample-on-your-enemies" tone of voice, with the motto, "Defiance not Defence."

In 1896 the memorial to the Empress Augusta was unveiled at Coblenz. The statue and the bas reliefs are in white marble by Professor Moes, of Carlsruhe, and the architectural portion by Bruno Schmitz, who occupies so distinguished a position in Germany. It is difficult to admire this work very greatly, but it aims at dignity and a happy union of the arts.

In Italy of late years monuments have been multiplied, and the chief of them have celebrated Garibaldi and King Victor Emanuel. That of Garibaldi, at Rome, erected on the Gianicolo, is by Professor Galloni. Although a national memorial, it does not seem a great work, in spite of fine passages; and the ultra-modern fighting groups at front and rear of the pedestal contrast oddly with the almost classic repose of the rest. Compare this equestrian group here with that on the Garibaldi monument at Milan and you will recognise a finer group, in which the tail of the horse recalls that in Alfred Stevens's unfinished model of the Duke of Wellington. This well-proportioned monument, with the fine figure of Italian liberty sheathing her sword, is by the sculptor, Ettore Ximenes.

They who think—there are a few, but not many—that a large sum ought not to be expended on our great memorial, should consider what is being done elsewhere in order to commemorate a great national hero and national event. To Victor Emanuel modern Italy owed her revival, her liberation, her consolidation into unity, as one great people and one nation, taking her place at last—after how great an interval!—among the great Powers of Europe. To him, it was felt, a mighty memorial should be raised—to him and to the Third Italy—and no sacrifice was thought too great to compass this end. The structure was to take the form of a vast scenic architectonic screen on the Capitoline Hill, and to provide for the inclusion of a great equestrian statue, to be led up to by flights of steps 27 metres high, which the sculptor, Signor Enrico Chiaradia, was to model. That group is now in existence, although I believe the plaster has not yet been cast into bronze.

In the first competition a hundred designs—all of them models—were sent in. In the second only six, to the first two of which a prize of £400 was to be allotted. The second prize was awarded to Signor Luigi Boffi for a design imposing for its size rather than by its taste (I am constrained to show these models by slides from wood-engravings as suitable photographs are not at present procurable). The little figures at the foot of the steps and on the first landing disclose the monstrous proportion intended.

The design of Bruno Schmitz, who was nearly successful for the Emperor Frederick memorial, and that of the Count Guiseppe Sacconi were bracketted first and each received the £2,000 premium. The series of steps in the case of the former seem to involve a terrible, almost a prohibitive, obstacle to any but the athlete and the man in training to mount near enough to the statue to examine it.

That of Signor Sacconi, who was at that time a young man of twenty-five, is of a finer aspect, and to it was finally awarded the commission. More elaborate than any we have yet seen, not so much as a structure as a series of structures, it was estimated to cost £360,000, but £320,000 were spent on the site, the substructure, and the preliminary operations. Although it was begun in 1884 it is by no means within sight of completion. Up to 1898 not less than £1,040,000 had been spent, and it is expected that before it is finished it will have cost £2,000,000 sterling. Of this sum, however, a good deal has gone, of course, in expropriations, and further expenditure has been incurred by the determination to vault over the interesting archæological remains discovered when the site was being cleared. A view of the sculptor's model may be more satisfactory

—the light and shade is better seen. Since then there have been numerous radical modifications, external and internal; the groups of sculpture in the open and in the Baldacchino, and the pan-Athenaic frieze, were for a time retained. Internally, there is the introduction of great vaulted halls below the marble terraces; and, externally, the suppression of the attic of the colonnade and the broadening of the frieze, the entablature being given a more pronounced monumental character. This drawing will show the great change which has taken place in the design in the lower story. The details, it will be seen, are pre-Palladian, and are based on more classic models. Against the aggregation of vast halls, marble terraces, and colonnades, rising one above the other, Chiaradia's gigantic statue-group will stand forth. The tiny figures indicated at the side of this reproduction from a watercolour drawing of the latest view illustrates the size and scale of the final work.

This is the tribute of impoverished Italy to her great King. To our greater Queen, wealthy England has as yet subscribed to her memorial but one-eighth part of the sum to be expended there, and so has crippled the whole scheme.

When we come to the statues and memorials of our own sovereigns we cannot help recognising how poor and commonplace in conception in the past has been the imagination which has produced them, to say nothing of the stinginess which has dictated the scale. Take the Bombay statue, which is said to be the delight of the Indian population as a whole. The statue of Queen Victoria, set up near the Telegraph-office, is by Noble, and was uncovered by Lord Northbrook in 1872. It is in white marble, and the pedestal and canopy have perhaps the chief interest; but the whole of it including the statue, as I have already remarked, is said to impress the native mind enormously. It cost 182,450 rupees, nominally, that is £18,250, of which the late Kande Rao Gaekwar contributed £16,500. This was for a long while the chief statue of Queen Victoria in India.

If such is the effect on the native mind, how will the population be impressed by the sight of the mighty memorial which India is about to erect to the glory of Queen Victoria, from the designs of Sir William Emerson. Subscribed for by the Indian public, by English residents, and by the native rajahs, who contributed munificent donations, this great building, erected on the Maidan in Calcutta, is estimated to cost not less than £350,000.

The building, faced entirely in white marble, Greek and Indian, is 340 feet long and 225 feet broad, and is raised 12 feet high on a terrace 35 or 40 feet wide that entirely surrounds it.

Italian Renaissance in style, with just a *soupçon* of Oriental flavour in the treatment of the domes and in certain details, the building is finely planned—in the form of a capital H—and contains Durbar, Queen's Hall, and Prince's Hall, with picture galleries, sculpture galleries, and galleries for the display of arms and trophies. It is led up to by a grand flight of steps, at the head of which will stand Mr. Frampton's statue of the Queen. The corner towers are 30 feet square, and the dome, 70 feet in internal diameter, is about 170 feet to the top of the gilded figure of "Victory," which surmounts it.

Beneath it is the circular Queen's Hall, lined with white marble and panels of the marbles of India; so that, in the middle of a beautiful and spacious park, there will rise the glittering marble structure upon a terrace of white marble, with the snowy dome soaring into the air, and visible from every point of the river and the Maidan.

What have we done in Great Britain as national, not as municipal efforts? We have the George III. in Waterloo-place, which was originally designed by M. C. Wyatt at the command of the king, as a "St. George and the Dragon" and which, on the monarch's death, was actually altered by the Government's order—a brilliant idea—from the saint to the king (by judicious addition of costume, exchange of helmet for periwig, and so on, and the removal of the superannuated dragon), and there is Tribute No. 1 to a deceased British Sovereign.

Then we have the Albert Memorial—a better thing than many are willing to allow, though greatly harmed by the poverty of many of its details and by the coldness of the invention. It merits more attention than the rest, for, whatever may be said of it as a whole, it was a very sincere effort to do the best that could be done, with the help of the men at the top of their profession; and it was by far the most costly monument which had ever been put up. Only £60,000 had been subscribed by the public—and that was the amount paid to the trustees whom the Queen had appointed. £500,000 were voted by Parliament. Sir G. Gilbert Scott, the architect, was paid his commission on £100,000; and so far as the archi-

tects were concerned, the prime cost of the monument was £142,916. The gilding of the spire alone cost £10,000, and Queen Victoria spent a very large sum out of her privy purse before the work was finished. She had originally desired an obelisk, but a suitable piece of granite could not be obtained; perhaps, too, she hesitated at the cost (you will remember that the Alexander column at St. Petersburg came to £400,000); but when it came to embellishing the Memorial, the Queen did not stint the cost, whatever it might be, in doing full honour to Prince Albert's memory.

There had been a limited competition, in which P. C. Hardwick, R.A., G. Gilbert Scott, R.A., Charles and Edward Barry, James Pennethorne, Professor Donaldson, and M. Digby Wyatt took part.

Scott's work was selected: it was not really one of Ruskin's "Gothic towers upon the ground"; but a copy of the Baldacchino, or rather of the true canopy over the altar at the east end of S. Paolo fiore le mure in Rome. It also resembles that in St. Cecilia, and in the Anjou tombs at Naples as well. The flèche is built at the intersection of the groining on a steel-girder gridiron flooring, which perhaps hardly shows the architect to great advantage beside Kemp, the untaught designer of the Scott Memorial, which requires no iron supports whatever in its valid construction. We must not forget, however, that iron ties are used freely in Gothic architecture in Italy and elsewhere—even in Westminster Abbey. But Scott did not choose to expose them.

The enormous mosaics were all designed and executed by Mr. John R. Clayton, who, since the failure of the gold, has recently succeeded in inventing a method of completely coating his tesseræ in glass, so preventing the gold from perishing from any cause whatever. It was he, the young friend of Gilbert Scott, who suggested, for the groups that were to be placed on the four awkwardly-exposed bases isolated from the monument, the appropriate subjects of the four quarters of the globe as emblematic of the Empire; and, on the same evening, being challenged, made a sketch for each. He saw that a great core was wanted for each group; and so introduced the biggest animal in each continent—the bull, elephant, camel, and buffalo. P. Macdowell, R.A., took "Europe"—very poor in design; Foley, "Asia"—a more scholarly arrangement; W. Theed, "Africa"; and John Bell, "America." Of the other figures, "Commerce" was entrusted to Thomas Thornycroft, and "Engineering" to John Lawlor, and the great frieze of figures in the Podium were carried out by Mr. Armstead, R.A., J. Birnie Philip, and Calder Marshall, R.A. The whole of the sculpture work is in Sicilian marble. The "Spire" is 175 feet in height. The work was begun in 1864, and was unveiled by Queen Victoria—without the seated figure of the Prince by Foley (that by Marochetti having been rejected)—in 1872; four years later the statue was completed, and the whole unveiled in 1876.

With these works before our eyes, and with these details of cost and periods occupied in construction, we are now in a position to judge of our new National Memorial, and of the designs submitted by the competitors.

These designs were produced under what might be called the "conditions" of the competition. These were merely verbal, and sufficiently wide and vague to avoid hampering the architect in any way. No estimate of cost could be suggested, as it was not known what amount would be subscribed. A plan of the Mall was provided; a suggestion made as to the designing of a processional road, opening out at the eastern end; with an architectural setting for the monument; with a necessary laying-out of the ground on the west; and with the further statement that Mr. Brock would design the monument, to which the architectural structures in the west would necessarily be subordinate. Mr. Brock then met the architects in council, and explained his ideas by the rough model he had made. In July, 1901, the announcement of Sir Aston Webb's success was made, and at the end of October an exhibition of all competitive designs was held in St. James's Palace, for the public to judge of the rightness of the committee's verdict. That there was much to be said for each individual design was but natural, in view of the great skill and eminence of each competing architect, each in his own line and in his own country; but there is no doubt that the general feeling has cordially endorsed the finding of the committee, and applauded the approval of His Majesty the King.

What these various designs are I now proceed to show, for without them it is difficult to appreciate to the full the merits of the winning work. Mr. Brock's monument I keep for the end. It is necessary that a few plans should be shown in order to make the dispositions clear. I begin with the contribution from Mr. T. G. Jackson, R.A.

Mr. Jackson would leave a delta at the east end, taking a centre line through King Charles I.'s statue to a point in the processional road opposite the north-west corner of the present Admiralty building; but he begins his real design just west of the steps of the Duke of York's Column. Here, to harmonise with this structure, he would have erected a magnificent triumphal arch, of imposing proportions and severe and noble design. The Marble Arch is, roughly, 43 feet high; the Wellington Arch, 62 feet. Mr. Jackson's stately design is 93 feet to the top of the cornice of the main order, and to the top of the finely-outlined bronze group is 120 feet.

The central *allée* is not a roadway but a public walk, 40 feet wide, the public carriage roads being north and south. The pathway would be flanked by grass plots, intervalled every few yards by a semi-circular *exedra* containing a statue. Mr. Jackson provides railings throughout the entire length which could be closed at night, as a protection against the vandalism to which neither London nor Berlin is a stranger.

The forecourt or square is a beautiful feature. It is enclosed by colonnades and contains gardens, fountains, and groups of sculpture representing the colonies and dependencies of the Empire. The colonnade has at its angles four pavilions with bronze groups representing arts and industries.

In the middle of this *parterre* the monument of Queen Victoria would rise, and the general aspect is in fine keeping, and characteristic of the brilliant artist who designed it.

Finally, it will be observed, Mr. Jackson is the only one of the competitors, besides Sir Aston Webb, who carries the traffic *outside* the forecourt or square northwards to Constitution-hill and southwards to Buckingham Palace-road.

In Mr. Ernest George's interesting plan, also a delta, aligned with the Strand, leads to a beautiful and imposing five-way gateway, full of simple dignity and elegance—a form novel as a triumphal arch, erected at the north-west corner of the Admiralty building; and six groups of statuary are allowed for along the processional road.

So far the arrangement is quite simple. The forecourt before the palace is very large—longer then is suggested by any other of the competitors—extending as far as the corner of Stafford-house. On an elongated *parterre* the monument is erected, and east and west is a low gushing fountain. Groups of four columns with entablatures carry statues at the sides, and provision is made for equestrian statues north and south. A high wall from the water leaves space for a formal quay-path round the west end of the ornamental lake, and at the east the forecourt is bounded by a semi-circular screen, consisting of a double colonnade with domed pavilions at intervals. The whole is highly refined and graceful, as would be expected from this distinguished architect.

Sir Thomas Drew, of Dublin, President of the Royal Hibernian Academy, recognising that the line from the Strand to the Palace is at present deflected at a point near the new Admiralty building, boldly strikes a new line, involving the re-alignment of the whole Mall with the monument as the axis. And he would have substituted a palisade of architectural dignity for the rather disfiguring frontage of the low line of buildings in front of Carlton-house-terrace.

Entering from the Strand, we find an approach, 110 feet wide, flanked by buildings stately in intention, leading to a curiously high triumphal arch which forms a monumental entrance to the great memorial avenue.

But the main feature of Sir Thomas Drew's design is that, apart from the enormous *parterre* 300 feet in diameter, he boldly tackles the façade of the Palace itself, and on that—insisting on it as the background of the monument—he lavishes most of his effort, and of the funds at his disposal. The front of Buckingham Palace, built in 1842, is universally condemned as a poor and undignified, not to say a shabby and incongruous, performance—unworthy, as the residence of the Ruler of our great Empire; and unworthy, also, as a background for the memorial. Sir Thomas Drew's idea was to re-cast the façade architecturally, in the decorated Renaissance style, without changing its fenestration or altering the internal arrangement, by applying a Corinthian order elevated on a rusticated or coursed basement, as an improvement on the present lowest storey. His design provides for raising pavilion-blocks one at each end, thrown out from the building like great wings—which would cast shadows to break the monotony of the erection. A serious objection to this, however, appears to be, that he would thus inevitably block out oblique views from many of the windows of the Palace. The whole, the architect estimates, could be done for about £100,000 or £120,000. But according to the terms of the competition the Palace was to be left out of account.

Sir Rowand Anderson, of Edinburgh, simplified in his design the Buckingham Palace end into a large semi-circular plateau, surrounded by a balustrade, edged with statues of great men of the Victoria era, with a small garden and fountain at each re-entering angle. By what was doubtless a misunderstanding he produced an elaborate symbolical design for the monument itself, of which, I understand, he had a model very carefully worked out at Messrs. Farmer and Brindley. As the commission for this had already been given to Mr. Brock, and architects were invited to conform to his ideas, this was outside the scope of the competition.

A great arch was to be erected at the north-west corner of the present Admiralty buildings; and there the design ends, a non-architectural opening thereafter debouching opposite King Charles's statue, without any special features. This structure is an elaborate two-storied triumphal arch, Renaissance in style, designed for an equestrian statue, either of the Prince Consort or the Duke of Wellington, in the upper arch. The traffic could pass round as well as through, as in the case of the Wellington Arch and the Marble Arch.

We now come to the accepted design, the design of Sir Aston Webb. This was generally held to comprise the greatest number of the best and most practical ideas. A fine and eminently practical opening to the east, with good vistas and generally symmetrical system; the relatively modest and quiet *ensemble*, well-calculated to be a setting to the monument, and not unduly to vie with it; the appropriateness, practical and ornamental, of the design, from beginning to end—especially with the modification now introduced—these are the merits which have secured general support to the Committee to whom fell the difficult task of selecting among the fine designs of several of the leading architects of the day. Sir Aston Webb is credited with having the widest experience in laying out plans on a large scale, and, in such work, in harmonising as it were, the claims of the artist with the needs of the public, having regard to the exigencies of the circumstances.

He, like the rest, seems to have rejoiced in the opportunity, rare in England, of bringing a fine road straight up to the great feature to be viewed. Although abroad everyone recognises this simple and, one would think, this obvious truth, in England it is consistently ignored even to the present day. Abroad, the road leads up to the monument, or palace, or view; in England, as Wren pointed out, we approach them sideways. You cannot drive straight up to Whitehall, to the Mansion House, the Bank, or to the Houses of Parliament (at least you could not when they were built), to Somerset House, the British Museum, and see them from any approaching roadway without turning your head. St. James's Palace was one of the only buildings which could be fairly driven up to; even the recently erected Law Courts and the Albert Memorial are passed by sideways on the road, and you look at them, as it were, with one eye.

It was evident that if the processional road was carried straight with the view to making an outlet on the east, Drummond's Bank would have to be acquired and removed at the cost of some £150,000 or even more, and for what? to open obliquely into Whitehall, ending nowhere, and revealing a view of a gigantic specimen of excessively commonplace architecture. [I show an enlargement of the right-hand, or eastern section of the plan, so that you can see better.]

Now, by taking the central axis of the West Strand—having in mind the noble effect of a fine view from that great thoroughfare—and letting it intersect with that of the Mall, Sir Aston Webb obtained a point just behind Drummond's Bank, where he masked, more or less, the change of axis by a large circular "Place," in the centre of which he proposes to have a statue of Queen Victoria at the time of her accession (a felicitous notion), so that the figure of the Queen at the commencement of her reign, begun in hopefulness, looks towards the end of it, accomplished in splendour. Large spaces were equally to be left opposite Waterloo-place and Marlborough-gate (to which I will more particularly refer in a moment), until after passing along a series of statuary, at the west end we come to the great central feature of Mr. Webb's design, the details of which have latterly been considerably modified, to meet the practical requirements and demands of the authorities. I now show the elevation of this plan.

It is, of course, part and parcel of the whole laying out. The careful and thoughtful planning of the whole, the approaches from Constitution-hill on the right and from Buckingham Palace-road on the left, admirably symmetrical and in all respects monumental, the large opening into the forecourt from the Mall as well as north and south, through which an unimpeded full-face view of the monument may be obtained, must strike everyone at a glance. There are

fountains inside the colonnade, steps down to the water, and the monument is backed by the great screen.

But subsequent modifications, shown on the screen, were several. The outer roadway is now abolished and the traffic is taken inside the great forecourt, in order that the people should not be banished so far away, doubly screened from the Palace, and that the gaiety of the traffic and the contiguity of the passers-by might be retained. The finely-proportioned double colonnade has therefore been brought up to the water edge, where the pathway now is; the present balustrade, as you can see it any day, was to be but the first course of the outer part of it.

The two series of steps leading down to it from the water were suppressed, so that a finer effect is obtained by a retaining-wall, unbroken by this incident; and the broad steps have also been abandoned; and, as at present arranged, the charming vista of the distant Foreign Office—the more charming for being distant—and of Westminster, has been secured.

The high architectural screen, consisting of a colonnade behind the monument, is superseded, as it might have interfered with the view of Mr. Brock's work. It is now replaced by a lower, but still a very effective, railing or balustrade nearer to the Palace. It had been feared that the original screen, together with the outer colonnade, would to some extent have cut off the view of the outer world—of the Mall and the park—from the windows of the Palace. But as may be seen in this early sketch from the Palace windows, this would not be the case, or at least only in part from the ground floor, which in palaces does not count. In looking at this view, you must bear in mind the modifications which Sir Aston Webb has since made.

To see just what these are, we must revert to the later plan; but for the sake of clearness I take it in sections—the Whitehall end first.

Here, as the Government could not give sufficient space for the great circus opening out into Whitehall, the architect reduced it in size and brought it westward by the length of its radius. Space is thus given for the erection of a large Government building of a decorative and monumental character, and on each side of it, as now intended, a circular "place."

This new building—which will probably be devoted to Admiralty purposes, for this first plan shows a bridge thrown across to it—would be crescent-shaped on both its faces: on that to Buckingham Palace and that to the Strand; so that the slight irregularity of its site and of its alignment should be entirely masked; and, as it will comprise a great monumental archway in the middle, the triumphal arch originally talked of is thus obtained, and the processional road ends worthily, for a utilitarian government, with a public building. This sketch scarcely does justice to the design.

The correct plan of this building is shown. From that point, westward, the processional road, as far as the space opposite the Duke of York's Column, is narrower than the rest, owing to the exigencies of the ground available. Between there and the memorial itself, the measurements are vastly more imposing. Two rows of trees were removed and set back so as to obtain a roadway 65 feet wide. Few of these trees were of any growth, and had never really flourished; and they have been replaced by younger trees, carefully planted in abundance of rich soil—in spite of which, however, all have not survived the transplanting. There will now be, therefore, the same number of trees as before—an important point, about which the public rightly showed itself much concerned.

The width, then of the chief roadway is 65 feet which, in the circumstances—in relation to its length and to the traffic—does not compare ill with the 90 feet of the Champs Elysées. That is to say, it is here 80 feet between the trees, as against 90 feet between the trees of the Champs Elysées. On each side is an alley of trees (with paths between), 25 feet wide—which form vistas, as it were, and are intended to be furnished at each break with groups of sculpture. These alleys flank the processional road. The road at the north is made into a riding road; but the southern one has been greatly restricted through the desire to avoid encroaching more than is absolutely necessary upon the public park.

Proceeding west, then, we arrive at the open space at the foot of the steps below the Duke of York's Column. As in Waterloo-place, above, are statues to our Eastern heroes, so the space below, by a continuity of idea, was to be devoted to the glorification, by means of emblematic groups, of the Eastern Dominions.

Thus, facing the steps at the north-east corner of the park, there will be two handsome gateways, and between, an important group was provided for, symbolical of "The Genius of the Orient;" and the four subsidiary

groups of statuary to represent Ceylon, Barbadoes, the China Ports, and India.

Opposite Marlborough-gate, provision is made for another handsome gateway into the park, and the "Place," 100 feet across, was to be embellished with statuary representing the Western Dominions, comprising Australia, Canada, New Zealand, and Newfoundland. (The nomenclature and classification, though happy, seem to me, at first sight, a little arbitrary, geographically speaking.)

At the western end of the processional road, nearest the Palace, are the two groups of statuary, representing South Africa, the Cape, and Natal. This is the view seen from Birdcage-walk.

It should be added that the present hideous and foolishly designed electric-light standards now set up, which have rightly been made the subject of public protest, are merely temporary. The lamps will be an important feature of the general design. Close around the monument itself, upon its platform, will be lights, about which I shall say a word presently. Mr. Brock puts eight incandescent lamps on the pavement around it, not shown in the view. On the outer side of the road are six groups of lamps, each consisting of a cluster of five each, within the semi-circular recesses, probably to be backed by a low stone parapet. The lamps, be it noted, are Mr. Brock's special charge, and will be in stone and sculptured bronze. I have seen the proposed design, which promises to be a revelation to the Londoner.

Thus, there will be three circles of lights which will mark the construction; and these, together with the lamps along the stone balustrade enclosing the forecourt in front of the Palace (which balustrade will be 10 feet high), will produce a very fine effect at night.

Finally, it should be observed, that there is a direct open approach to Mr. Brock's monument from the Mall from between imposing piers; another from the south, that is to say, from Birdcage-walk, whence a view of one of the finest groups will be afforded; and, similarly from the north; another, by a tree-skirted *tapis vert*, a grass-planted avenue of the same width as the main roads—65 feet, which extend northward in the Green Park, so bringing the monument directly into touch with Piccadilly. And it is approached by handsome gates and piers, now in the course of erection. These will be surmounted with handsome figures of boys instead of the usual urns.

It will be seen that Sir Aston Webb has adopted a style of quiet and unpretentious classic type, dignified and harmonious, and sufficiently monumental. The whole is admirably and consistently planned, in complete sympathy with the work of the sculptor; and the result of this cordial collaboration was to be a vast work of decoration, now unhappily much curtailed, but which will still be a splendid ornament of London, and a worthy bequest by the twentieth century to the London of the future.

I now come to the work of Mr. Brock. I may be permitted, first, to refresh your memory of some of the chief works by the sculptor, who was selected without the formality of a competition to carry into execution this great work. In 1866, Mr. Brock had entered the studio of Foley, and when his career was well assured, he had the rare courage, and elasticity of mind and spirit, to modify his style in accordance with the newer current of artistic thought and feeling, and so developed, he left his master far behind.

His first important ideal work that marked his transition was "A Moment of Peril"—a fine scholarly group, soon to be surpassed in technical quality and refinement of taste. This we see in "The Genius of Poetry"—graceful and reposeful where the other was violent in action and passionate; sculpturesque, where that was, in a measure, romantic and anecdotal. Then a higher point was reached in "Eve," so touching in attitude, and so human in the sentiment of remorse—just a fair, shamed woman, purposely not endowed with that conventional perfection of beauty with which the first mother is by artists commonly endowed.

In portraiture, Mr. Brock has been similarly successful. In "Dr. Philpott, Bishop of Worcester," there is not only striking likeness. It is admirable and characteristic in pose, solving the eternal problem of the upraised arm, and showing an admirable and refined treatment of drapery, with its shallow depressions, without black holes of shadow, and its expressive crispness of the edges. "Sir Richard Owen" shows similar handling and a complete mastery of the figure and, above all, of character.

In striking contrast with these is the "Edward the Black Prince," the colossal work lately set up in Leeds, where it is far more imposing in effect and colour than when it was seen, gilded, like Falguière's "Joan of Arc," in the quadrangle of Burlington-house. It seemed

curiously significant that a well-known writer, animadverting upon modern sculpture, found fault with this group on the simple ground that it was not the equal of Verrocchio's "Colleoni" in Venice, the most magnificent equestrian statue in the world.

Then we have what is perhaps Mr. Brock's masterpiece, by which the memory of Lord Leighton is to be kept green in the aisle of St. Paul's Cathedral. Admirable in proportion, in harmony of design, and line, and in silhouette—in conception, sentiment, and detail—this is a monument in which the President himself would have rejoiced—for all is beauty, dignity, and repose.

But when Mr. Brock was still a young man he had produced a monument of an important and elaborate character. This is his "Daniel O'Connell" in Dublin, in which he showed a richness of design and a certain stateliness of line and character that might be based upon foreign monuments we know abroad, yet still impresses us as one of the finer out-of-door monuments in Great Britain.

But a work, more appropriate to the subject in hand, and necessarily more sweet and tender in feeling, is the bust of her late Majesty, Queen Victoria—one of the noblest, most dignified and exquisite works of its class in England—full of tenderness, delicately and lovingly rendered. Carried so far that the marble almost breathes, it remains sculpture, free from trick. And the whole is a most finished and beautiful rendering of the Queen at her best—elegant, thoughtful, wise, and solemn.

These, then, are a few typical examples of Mr. Brock's work, which, if not completely representative, are sufficient to show the high achievement and the calibre of the man whose sketch-models we are now to see. Hastily summoned to make a sketch, without delay, for the King to consider, he thought out and produced within three weeks this rough clay model of what he proposed for the central feature. [The little figures on the steps are intended to show the scale.]

The final model is now completed in all its parts—as you have probably seen in the winter exhibition of the Royal Academy—but as it is a model, you must not judge it as a finished work. The artist, exercising a wise prudence—and as a precaution against eventualities such as the world has had such bitter experience of—has determined to complete the models for the whole undertaking, before he begins a single touch on the actual work itself. I must warn you that it is in the staring white new plaster, photographed in the studio—so that we cannot fairly judge of the effect of the work as it will be. I show the central figure first. It is on a one-tenth scale, so that this portion of the monument, the model being 7 feet 6 inches high, will be 75 feet from the steps at the base to the tip of the Victory's wing.

The idea is, the Great Queen—seated amid the personifications of the personal qualities that made her great. At the right is a group representing "Justice"; at the left, "Truth"; and at the back "Motherhood." Above are "Courage" on the right, and "Constancy" on the left—qualities which, with the others, bring about the triumph of "Victory"—"Victory" which surmounts and dominates, as it were, the whole structure of her virtues, and crowns her glorious reign.

Around the base are freely-treated ships' prows—two bearing trophies suggestive of the Army and Navy, and two, fruits and flowers, emblematic of Commerce and Prosperity.

Above the slightly pyramidal core, at the feet of "Constancy" and "Courage"—appears an Eagle—the "Eagle of Empire," a most valuable and felicitous architectural form.

It has been objected that the eagle, really an heraldic badge, is not, in fact, an imperial device at all; as it is the common symbol of the American Republic and the Kingdom of Prussia. I do not think that the objection is sound, as the eagle was, to go no further back, the emblem of the Roman Empire, as it has been, in modern times, of the empires of Russia, Germany, Austria, and France; and even republics and kingdoms can be identified with empire; a claim, surely, which will not be denied to Great Britain.

As a few details of the monument should be examined, I shall, as it were, turn the work round for you. In the group of "Justice," which we must recognise as quite admirably composed, the winged figure of Justice holds the sword and protects the weak; while the boy, ever young, bears the scales. The emblem of the lily appears on the pilasters.

We here have the full view as seen from the Green Park. It shows well how the figure of the Queen exceeds in scale all the others, in a just proportion.

"Motherhood" with its chief figure, embracing two of her children, while the third is on the ground, is a tender composition, excel-

lently treated and full of charm. This the view from the Palace.

In the group representing "Truth," the genius holds the mirror; the palm branch is grasped by the child, the personification of truth, and the seated figure searches for truth in the written word.

"Constancy" and "Courage," which in their power and handling seem to suggest Alfred Stevens, form a fine base at the feet of "Victory" on her crystal globe. "Victory," it should be observed, not exultant over crushed and fallen enemies, but, pointing Heavenwards, triumphant over all that is unworthy, mean, or foul in character and conduct.

This portion of the monument will probably be in bronze gilt; the rest, of white Carrara marble, or, it is to be hoped, of some finely-toned stone. The figure of the Queen, which, as it sits, will be thirteen feet high, is draped in her robes of State—the only statue, I believe, in which the seated Queen wears her robes from the shoulders. The drapery is finely disposed, and the whole figure has an imposing and impressive air as it projects from the architectural throne and niche, with its rose-decorated pilasters. Allow me to repeat that these photographs are only from plaster models, and that the figure of the Queen in this model is not more than 15 inches high. This model is now in course of being enlarged to five times this size—that is to say to one-half the full, final size, as it is not safe to enlarge at once from the model to the enormous proportions it is finally to take. Even this half-size is considerably above life-size, and it is being elaborated with all the minute care essential to so important a work.

In order to show you how the work is progressing, I place before you a view, taken last week in Mr. Brock's studio, of the panel to one of the fountains, representing a water-nymph. This is a detail, of what might be called of secondary importance, and is, as you see, still in the clay and not yet quite finished. Yet the length of the nymph is not less than 12 feet.

The general view shows the monument on its platform, 70 feet wide.

At each side is a great fountain, discharging down steps into a basin 160 feet long and 28 feet across. That on the right typifies "Power," and the figures, which, in the manner of Michael Angelo's Medici figures, preside over the fountains, personify: the male (with a helmet), the Army, and the female (with a ship), the Navy—the foundations of the monarchy. The sea-nymph which you just saw is below, in the panel—colossal in size; and on the right and left are bronze reliefs elaborating the idea of the two Services. The parapet is 8 feet 6 inches high. The little figures standing at the edge are of the size of life, and are modelled to scale.

Corresponding with this *motif* of "Power," we have, on the other side, "Intelligence" (which quality presumably is not denied also to the Services). Here the two figures represent: the male, with the dynamo, "Science," and the female, with the palette, "Art;" a Triton reclines below. The reliefs here have for their subject the "Progress of Science and Art." The water, it should be explained, is obtained from the overflow from the Serpentine, and will be running day and night, and thence fall into the ornamental waters of St. James's-park, below.

Around the main parapet, between the monument and the fountain-basins, fine bronze lamps, it is at present intended, will be erected; but whether these will be short and richly massive, or tall and elegant, has not yet been decided. To my mind, the short ones will interfere less with the view of the monument itself.

Around the central feature, four statues accompanied by lions will be erected. In front, on the left is "Progress"; on the right "Peace"; and at the back, on the left, "Manufacture," and on the right, "Agriculture."

The pavement, so important in the case of a monumental undertaking such as this, is usually neglected in England; irregular stones and narrow kerbs often mar the effect which abroad is always carefully considered. In this case it is hoped that the pavement will be composed of sawn grey granite slabs. Outside the monument 25 feet has been left for the side-walk. If that pavement and the whole of the monument could be raised 24 inches and reached by three steps, the effect would be very fine. But it would mean 1,800 feet of triple granite steps, and that is an expensive item.

Then there are two other important features. In the middle of each section of Sir Aston Webb's semi-circular screen, showing inwards, is a pavilion before which Mr. Brock erects two elaborate fountains, of which the designs are not yet sufficiently advanced to be placed before you. The subjects are Empire and Progress, and gushing water will make a continual play of light and sound, and add

gaiety to the grass and flower-planted enclosure which Sir Aston Webb prettily calls "The Queen's Garden."

Now, it has unhappily been quite recently decided that the funds available do not permit of the larger scheme being carried into effect. I am informed that the series of sculptures in the processional road are to be suppressed; and as the colonies contributed considerable sums, the gates with the armorial decorations of arms and emblems of those colonies and the sculptures facing them on the side fountains, will be set up in their names, with a bronze plate to record their respective participation. Thus, the Mall side is allotted to Australia—that on the north (facing Piccadilly) to Canada; the entrance from the processional road, to South Africa; while, of the great fountains in the quadrants—that to the south-east will be in the name of West Africa and the Indian Dependencies, and that to the north-east to Newfoundland and the West Indies.

Speaking for myself, I am of opinion that the comparative failure of subscriptions ought not to be allowed to cripple the great scheme as it was finally passed, and if the contributions are not sufficient Parliament should be moved to make it good—£10,000 or £20,000 a year for five years—though it might wring, would not break, the heart of the Chancellor of the Exchequer. The occasion is unique; and the object one which would appeal to the nation at large.

The whole work, it is satisfactory to know, is to be carried out in the finest and most enduring materials, both the sculptural and architectural portions. Twelve thousand cubic feet of marble will be required for the main feature, and, if the fountain basins are lined with marble, 7,000 feet more. The numerous groups of sculpture on the processional road, representing the various Colonies and Dependencies, were to be under the full control of Mr. Brock, who, it was arranged, would place the commissions for them amongst our most competent young sculptors, and, being responsible for them, would, of course, retain control and see that they should harmonise in design and in spirit with the general scheme.

The one unsatisfactory feature would be the retention of the present commonplace façade of the Palace. It is, as Mr. Statham so vigorously puts it in *The Builder*, "a miserable anti-climax. Nothing can get over that. Give the Palace a new front, or the whole thing is lame and incomplete." Now, Sir Aston Webb has aimed at some improvement of the sky-line by placing Mansard roofs on the centre and the ends of the east front; but that is not enough. Now that we have a magnificent Processional Road—one of the finest in Europe—to lead up to the Palace, we ought to have a fine Palace for this magnificent Processional Road to lead up to. When that is done, we shall have performed our task completely, and paid the tribute of our homage to Queen Victoria.

Such, then, is the monument to the Queen; a design, if it be carried out on the grand scale originally intended, so finely conceived, that even those who are familiar with what has already been done upon the ground can call up but a mere mental sketch of the imposing aspect of the completed work as it was designed. It may be finished in five or six years. It may seem a long while; yet it is but a brief space compared with the 12 years of the Albert Memorial, the 27 of the Nelson Memorial in Trafalgar-square, the 20 years which have been expended on the Victor Emanuel Monument, with so slight a present showing for it. The years will fly—all too soon for most of us—and, whatever be the outcome, we shall see a memorial worthy of the artists who fashioned it, not unworthy of the nation who raised it, or of the great and noble Sovereign whose memory it is designed to honour.

DISCUSSION.

Mr. SIDNEY LEE said that he had listened with very great interest to the paper. All must regret that owing to want of money, the full design was not carried out, and he cordially sympathised with what the author had said as to the desirability of Parliament and the Chancellor of the Exchequer coming to the rescue of Mr. Brock's and Sir Aston Webb's efforts.

Sir CHARLES LAWES WITTEWRONGE, Bart., remarked that the only point which had struck him in nearly all the views that the author had shown was that the sculpture had been too large for the building, and he thought that was also the case in the Queen Victoria Memorial. It swamped Buckingham Palace—not that much mattered—but still as a question of art, the memorial should be subject to the buildings which were behind. In the case of Berlin, also, the sculpture was a great deal too large for the buildings.

Mr. ALFRED EAST, A.R.A., thought the members were very much indebted to the author for his paper, which would do a good deal of good by stimulating public interest in the memorial. He very much

wished that some millionaires had been present, and had been roused by the address to put their hands in their pockets to make up the deficiency in the funds of the memorial to which the author had referred. Everybody wished that the scheme had been carried out in the way in which it was originally designed. It seemed a pity that, in a great and wealthy country like England, such a comparatively small sum should not be forthcoming. He would have liked to have seen the memorial erected directly by the nation, rather than by Parliament, *i.e.*, that every person who admired the late Queen should show their appreciation of her worth by contributing to her memorial. Had the question been taken up immediately after her death, he believed the money might have been secured. He hoped it was not too late even now to collect all the money which was necessary to carry out the original design. This meeting, he hoped, would stimulate the desire and the privilege of wealthy men to contribute to the scheme.

Mr. HARRY FURNISS said that before coming to the meeting he hardly thought the subject was a humorous one, but after hearing the admirable paper he felt there was some chance for men belonging to the class of low art to which he belonged, to make some money out of the Victoria Memorial, when it was completed. In his opinion the only good design shown by the author was that of the Irishman, he was the only man who seemed to understand the nation he was working for, because it struck him (the speaker) that in the end there would be buildings all round and nothing else. The paper might stimulate the British public to supply the funds for the completion of the design; but from what he could gather, if it did not do so, by degrees all the original design would disappear, and something which was outside it would be substituted. It rather reminded him of the old Irish story of the builders who were employed to preserve a church by putting a wall round it, whereupon they pulled down the church to supply the material with which to build the wall. He thought that would happen in the present case. He hardly liked to trust to his tongue any longer, because he rose with the intention of saying something flattering to the author, and nothing else. He would, therefore, only add that he was sure all present were deeply grateful to Mr. Spielmann for the admirable way in which he had brought the subject under the notice of the meeting, and for the delightful evening they had spent.

Mr. PERCIVAL HUGHES said, as one of the public he thought he might prophesy that the effect of the admirable paper they had just heard would be to stimulate the interest of the public in this great undertaking. If there was one thing required in London, and in which England was behind every other nation and capital, it was in the taste for architecture and sculpture. He thought England had quite enough public libraries, and if only some millionaire could be induced to turn his attention towards improving the sites of London, when opportunities were given for the erection of sculpture and architecture, he would be a public benefactor who would do some good for the public taste. He thought that most of the remarks which were made should be in the direction of congratulating the author upon the extremely admirable and interesting paper he had given. It had been not only interesting but educational; and he could not help feeling that the audience would be extremely grateful if more such papers were given to educate the public taste. It was the first time he had had the pleasure of coming to the Society of Arts, but he was sure it would not be the last; and he hoped that every evening would be as interesting as the one he had now spent.

The CHAIRMAN said it was natural that, as an architect, he should sympathise with and emphasise the remarks which had been made in regard to the alliance of architecture and sculpture. Sculpture in architecture was of great assistance in giving expression to, and giving an idea of, the purpose and object of the building; and architecture was equally important to sculpture, for it should be as a beautiful setting to the valuable jewel. The architect and sculptor should, he felt confident, work together from the very beginning. Mr. Brock had made that remark to him only a few days ago when they were discussing the matter; and almost all the monuments, if not all, which the author had shown upon the screen had been carried out by the architect and sculptor working together from the beginning. In the case of the Queen Victoria Memorial the sculptor was called in and commissioned to do the work, and had already made out his scheme before the competition for the architecture took place. It was so far fortunate that, in the present instance Sir Aston Webb was successful in winning the competition, because both Sir Aston and Mr. Brock were very much in sympathy with each other, and with their respective work, so that the result he hoped would turn out to be very satisfactory. He could imagine the remark being made, that although the piers had been erected, and certain balustrades had been put up, there was no appearance of the fine colonnade that was to surround the central group. It looked very much from the work as if that feature was to be omitted. He sincerely hoped that was not so, because it was a most important feature of the scheme, and would give great value to Mr. Brock's work. It would give scale to it, because they could not always expect to have the little figures fixed down by the side of the group to show the scale, so that there would be really nothing there besides the big piers, which would be valueless for that purpose, and the palace in the rear; whereas if the colonnade was carried out, one would be able to judge something of the size and importance of Mr.

Brock's beautiful design. Not only would it give the work scale, but it was a shrine which was necessary, and would form, as he had already said, a beautiful setting for the jewel which was put in the centre. The screen also would not hide the beauties of the park, because on the ground level it would only be framed by the columns, and he also believed there would be no obstruction from the Palace; the view would still be the same. The importance of the colonnade was that it gave value to Mr. Brock's work, and made it a fitting tribute to Her late Majesty. If the group was left alone out in the open it did not appear to him to be quite respectful. He looked upon the colonnade as a sort of architectural batallion in attendance on the great Queen, and he thought it would be a great calamity if it was not built. If funds were wanted to carry out such a feature, there should be no difficulty in obtaining them, and if an appeal was made at once he was sure sufficient funds would be forthcoming to supply what, in his opinion as an architect, was a most important feature of the whole work. On behalf of the audience he wished to express to Mr. Spielmann their thanks for the admirable and interesting paper that he had read.

The resolution having been carried unanimously,

Mr. SPIELMANN, in reply, said he was very grateful to the President of the Royal Institute of British Architects, and also to the other gentlemen who had spoken so kindly about his paper. He regretted that there had not been very much in the form of criticism to which one could reply. He thought it was quite hopeless at the present time to consider that the colonnade would be carried out. He was not sure that the question of money, which of course was a very serious one, was the only objection; it was quite possible that in the future the plan might be continued; at any rate, that it would not be relegated absolutely to one side. The collaboration of an architect and a sculptor was, as had been mentioned, practically unknown in this country, but a start had been made, with very happy results, in the Queen Victoria Memorial which had lately been put up at Bradford, where Mr. Drury as the sculptor, and Mr. Simpson as the architect, worked together from the beginning, and had produced an extremely original work, which had the great merit of being entirely cohesive and harmonious. He was extremely obliged to all present for the very cordial reception they had given to his paper.

Mr. PHILIP NEWMAN writes:—I should like to add a few words to the chorus of approval of Mr. Spielmann's paper, and to refer to Sir Charles Lawes Wittewronge's dictum on the relative scale of sculpture and architecture. While all must agree that great disproportion between the figures themselves in the same monument is (as was fully illustrated) an artistic mistake, Sir Charles's contention that sculpture is often so large as to dwarf its architectural setting or surrounding should scarcely pass unchallenged. The question raised is an academical one, not only reflecting on the present subject and scheme, but on a canon of Greek taste as evidenced in too many instances to enumerate.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 8, 1905; the Right Hon. LORD REDESDALE, K.C.V.O., C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Adams, John Henry Maudslay, Broughton Cottage, St. James's-road, Waverley, Sydney, New South Wales, Australia.

Davis, Joseph Edward, 24, Maple-road, St. Thomas, Exeter.

Dewhurst, Wynford, Chelmscote, Leighton Buzzard.

Griffith, Samuel Barnes, 8, John-street, Adelphi, W.C.

Holding, Edwin, Balmain, New South Wales, Australia.

Kilburn, Bertram Edward Dunbar, M.A., Assoc.M. Inst.C.E., 6, Stanhope-street, Hyde-park, W.

Lawson, Eric St. John, Bangkok, Siam.

Medley, Charles Powis, A.M.I.Mech.E., 103, Worship-street, E.C.

Mocatta, Elkan B., 31, Great Cumberland-place, W.

Munton, Frederick Thomas, F.C.S., Beaconfield, Weston-road, Runcorn.

Newcombe, Robert William, 9, Groveland-avenue, Hoylake, Cheshire.

Ross, James William George, 143, Mitcham-lane, Streatham, S.W.

Tepowa, Adebiyi, Customs House, Calabar, West Africa.

The following candidates were ballotted for and duly elected members of the Society.—

Bacon, John Henry Frederick, A.R.A., 33, St. John's Wood-road, N.W.

Dickson-Brown, S., M.A., 31, Regent-square, W.C.

Earnshaw, Henry, 14, St. Mary-axe, E.C.

Evans, William Bailey, 20, West-parade, Huddersfield.

Fergie, George, Copiapó, Chili, South America.

Lello, Montague Nodes, 100, Belsize-road, South Hampstead, N.W.

Little, Robert, Singapore, Straits Settlements.

Minett, Richard, F.S.A.A., Municipal Offices, Cheltenham, and Cedar-lodge, Cheltenham.

Rolfe, William, 3, Adelaide-street, Charing-cross, W.C.

Steuart, James, 205, Clay-street, Baltimore, Maryland, U.S.A.

Tosh, William, J.P., M.I.Mech.E., P.O. Box 1132, Johannesburg, Transvaal, South Africa.
Williams, D. Neziah, 29 Tudor-terrace, Merthyr Tydfil, Glamorganshire

The CHAIRMAN, in opening the meeting, assured the audience that he was using no idle words when he said that he felt it a very great honour to have been asked to preside over a meeting at which a paper was to be read by His Excellency, Baron Suyematsu, an ex minister of the Interior in Japan, and a man connected with all that was best and noblest in his native country. He knew well that the first duty of a Chairman was to efface himself; he should be like the man who beat the drum and clashed the cymbals outside a show at a fair inviting the public to come in and see the giant; and he therefore would only assure the author that he would receive a most cordial and sympathetic welcome from the audience.

The paper read was—

THE ETHICS OF JAPAN.

By BARON KENCHO SUYEMATSU, B.A., LL.M.

I have been asked by your Council to read before you a paper on the ethics of Japan, and this is my attempt in response to that request, though very imperfect it must necessarily be.

There are three sources of factors which influenced the moulding of the ethical system in Japan, namely Shintoism, Buddhism and Confucianism. The first is the native religion of Japan; the second is, needless to say, a religion originated in India and introduced to Japan through China and Korea; and the third is the moral teaching of China. As to the relative positions of these three, I have already fully explained this in an article entitled "The Religions of Japan," in the December number of the *Independent Review*. They are not antagonistic to one another, as people not living in Japan might imagine, and as would only appear natural to them from their own notions of religion. Of these three, Buddhism is the most religion-like in the ordinary sense of the term. Shintoism ranks next, but it is very simple and liberal if viewed in the light of a religion. Confucianism comes last; it is ordinarily classed by Western writers as a religion, but as a matter of fact its religious aspect is very vague, and it is not considered a religion by the Orientals. Perhaps a better term for it would be the Chinese teaching of morality, because moral notions which can be gathered from Chinese study are comprised in all sorts of Chinese writings, and Confucius, the great sage, is only one of the exponents thereof. Confucius, however, takes a very high place among those exponents, and therefore he came to be revered more than any others by Orientals, and thus Chinese teaching came to be usually associated with the name of that great sage. I cannot do better than follow this example and call Chinese teaching by the name of Confucianism.

Comparing these three systems of teachings with regard to ethics, Confucianism stands out very prominently in its systematic exposition and practical utility. Buddhism it is said is very philosophical, and deep in its ideas of the cosmos, and there is no doubt that it is capable of exercising a great influence on the popular notion of a future life, though it does not do so as much in Japan as in some parts of the Asiatic continent. It has, however, very little to say with regard to ethics relative to the actual life of the human being. It says you must not do wrong—it says you must do good —but as to what is good or what is bad it is very vague in its meaning. It suggests rather religious notions than practical ethics, how one should behave in this world towards one's fellow creatures or towards the community or State to which one belongs. It speaks of ten warnings and four benevolences. The ten warnings are:—1. Do not kill the living. 2. Do not steal. 3. Do not commit adultery. 4. Do not speak wantonly. 5. Do not make sensational exaggerations. 6. Do not calumniate. 7. Do not use a double tongue. 8. Do not be greedy. 9. Do not be angry. 10. Do not entertain crooked views.

The four benevolences which one has to remember are:—1. The father and the mother. 2. The ruler of the land. 3. "All beings." 4. The three treasures, *i.e.*, the Buddha, the Laws, and the Priesthood (Order).

It speaks of compassion and forbearance. It also speaks of eight correct ways:—1. Correct views. 2. Correct thoughts. 3. Correct words. 4. Correct conduct. 5. Correct living. 6. Correct ministration, meaning self-reflection and aspirations. 7. Correct conception. 8. Correct mediation. In their essence, however, all these teachings are mostly of negative character, and, moreover, I must say that they have more importance from a religious point of view than from an ordinary, and a practical ethical point of view. Therefore I can say that Buddhism has very little to do with the ethics of Japan in the sense of a systematic exposition of them, though in an indirect way it has had some influence on

the moral atmosphere of the Japanese, as I shall show later on.

The Chinese teaching, otherwise called Confucianism, is a system of moral teaching founded upon a patriarchal system of community. It does not, therefore, only speak of the good conduct of an individual, as relating to his fellowship with other individuals; but also from the point of view of the whole system of community as a state. Therefore it speaks of modes of governing and of being governed, as well as of individual relationship between man and man. It does not recognise any difference between sovereignty and ruler, nor does it notice a difference between State and country. In it, the greatest natural bonds of humanity are five, and they are:—1. Sovereign and subjects. 2. Father (implying also mother) and child. 3. Husband and wife. 4. Brothers (implying also sisters). 6. Friends. To each of these relationships, the essential duty which is to be borne in mind by each individual is separately attributed, and to each of these duties a special term is given to designate its actions from the point of view of a virtuous nature. Besides these five relationships there are two other relationships which have to be added, namely, the relationship between the elder and the younger, not necessarily meaning brothers, and also the relationship between master and pupil. The term, "the sovereign and subjects," in Oriental notions, signifies in their bearing a very deep meaning in their mutual relationship. I once heard from a very trustworthy authority that a Western diplomatist, well versed in Oriental affairs, had said that the Oriental idea concerning sovereign and subjects was not, and could not, be thoroughly understood by Occidentals, and I think that remark is not far from the truth.

The idea of the best virtue that a sovereign can have is "jen," meaning to be as humane as possible to his subjects, detesting oppression, giving the best administration to his country—in a word, to be the best ruler that ever ruled a land. The idea of the best subject is loyalty. The idea of that of father and son is filial piety on the part of the child, and strictness on the part of the father, which is modified in the case of the mother towards tenderness, for which there is a special term. The idea which governs the relationship between man and wife is harmony. The older word for this was "distinction," meaning "not to be unseemly," but the word "harmony" is also used sometimes, and we Japanese prefer it. The idea of that of brothers and sisters is brotherly friendship, for which also a special word exists. The idea of that of friends is trustworthiness. In this way all the five cardinal bonds are dictated by desirable manifestations of sympathetic attentions to one another. But of course more prominence is given to the virtue of a subject, a child, or younger brother, in the case of a sovereign and subjects, of parents and children, and of brothers respectively. Then, again, the elder and the younger in general are expected to respect each other as the case demands, and the relationship between them is to be regulated by a term which is equivalent to the English word "order," that is to say, the younger should not seek to supersede the elder, but to pay respect to him, whilst the elder is expected not to take advantage of the younger but to treat him with kindness. The relationship between master and pupil is also regarded as very important. The pupils are expected to respect their master almost as much as their parents, whilst the master is expected to treat his pupils with parental kindness; no businesslike thought is to enter their minds. In the olden times in the East the system of teaching and learning was very different to that which exists in these modern days. The teacher taught his pupils out of the love of imparting his knowledge and virtuous example, as well as the doctrinal principles he entertained, whilst the pupils were supposed to gather around him out of their admiration for the personality of their master and for the purpose of receiving his instructions and influence for their personal improvement and future usefulness. Such being the case, it was no wonder that the relationship between a master and his pupil was regarded with so much importance in ethics.

Apart from these classifications the virtuous attributes of man are spoken of in several other ways. We have first of all "wisdom, humanity, and courage." These three are considered to be the three greatest traits of character to be embodied in one person. Wisdom may not exactly fall under the category of a virtue in its strictest sense, but I suppose we need not be very critical on this point. In this instance humanity, that is "jen" in the Chinese original, may be interpreted as comprising every other virtue besides mere mercifulness. There is another catalogue, viz.: "humanity, justice, decorum, wisdom, and faithfulness." These five are considered essential elements of virtue for regulating a community, and should be

observed by each member of it. There is another—"filial piety, brotherly friendship, loyalty, and faithfulness;" these give guidance to a man in his capacity of a son, a brother, a subject, and a friend. There is yet another—"sympatheticability, goodness, respectfulness, self-restraint, and modesty." These are virtues considered important as regards one's self-control. As to the women, "quietness, modesty, and purity" are considered the ideal traits of their character, besides all those which I have just described above, which are of course applicable to women to an extent almost equal to men.

In the West the term love plays an extensive part in governing all the mutual relationships of the kinds enumerated above. The essence of Oriental ideas does not differ from it in its purport, but expressed in words the word love does not play so extensive and imperative a part as it does in the West, because in the Confucian doctrine different technical terms are used, as we have already seen, to meet each particular case. The word love is used very sparingly in the Confucian books, and it is used more especially for designating one kind of virtue as, for example, "extensive love" meaning philanthropy in the Western sense. The word "jen," which ordinarily may be translated as humanity, more resembles the Western word love, because that word "jen" may be interpreted in many ways suitable to the occasion on which it is used, almost in the same way, and in a similar sense, that the word love can be used. But the meaning of that word "jen" is more comprehensive and deeper because it implies some other meaning than mere attachment. I will not worry you by going into full details of the interpretation of that word, as it is too technical. There is, however, one thing worth noticing about the word love in Chinese. When that word is singled out it is also applicable to many cases, including the relationship above enumerated. Thus it can be used in a very comprehensive manner, and thence there arises a question about the essence of the word. The question is whether the notion of love is absolute, and consequently has no gradation or differentiation in its nature. At the time of Mencius, sometime after Confucius, there was a school of philosophers who maintained that there ought not be any differentiation, but Mencius maintained that that was a fallacy. The word may be the same, but the practice may be differentiated according to the circumstances. The meaning is that one should love a nearer object more than a distant one, and thus the ethical notion of cosmopolitanism was reconciled with other notions of different virtues—in other words, if one does good to his neighbour more than to a stranger, or if one does more good to his country than to other lands, out of the feeling of love, it is quite justifiable from an ethical point of view, and thus Chinese ethics are made reconcilable with the principles of state. And this is, I think, an important landmark in which Confucianism differs from the features of an ordinary religion, which in its essence is, as a rule, founded upon cosmopolitanism, and knows not an artificial boundary of states.

There is a Chinese maxim which says, "No loyal subject serves two masters, and no virtuous woman sees two men." The cardinal points of the Chinese ethics are loyalty and filial piety; so that, although all sorts of virtues are inculcated, greater importance is placed on these two points. In China, learning means studying moral teaching. There are, of course, many subjects for study, but moral notions pervade every branch of literature. It is so, even with history. Chinese histories, as a rule, record only events as they occur; they have no historical or political observations, and any observations made by the writers are written in such a way as to draw attention from a moral standpoint. Their histories, therefore, have very little value in the ordinary sense of history, as the term is employed among Western nations, but the fact remains that they pay much attention to moral lessons. Their expositions of moral teaching are done more in the way of philosophical or scholastic dissertations. The ethics of China, however, were not necessarily identical throughout the long period of her history, extending over several tens of centuries. There were several schools of philosophers besides Confucius, some of whom even went so far as to differ from him in many points; and also the interpretations of Confucianism differed at different epochs. But the chief feature of his teaching has always remained the same, and all that I have said about it above represents fairly the idea of Confucian doctrine. It is natural that Confucianism should be regarded as a sort of religion, because its followers respect it almost as a believer in religion respects his creed; moreover, Confucianism recognises in a measure the existence of some supreme power. It speaks of heaven in the sense of a power; it speaks of the "order of heaven;" it even

speaks of the "supreme emperor," meaning the supreme being. It also recognises the immortality of the soul, though in a vague manner, and pays great attention to festivals given in honour of one's ancestors; to use a common phrase, it worships the ancestors. But the parts of Confucianism which relate to the future of man only form a subordinate element of it, so much so that Confucius himself once said, "I do not yet know the living, how can I know the dead?" At all events I, in common with most Orientals, do not regard Confucianism as a religion in its ordinary sense. There are of course many customs and matters of etiquette sanctioned by Confucianism, or rather enforced by it, which are absurd or impracticable in the eyes of the Japanese, but there is no necessity for me to dwell upon these shortcomings here.

Let us now see what is Shintoism. It is essentially indigenous to the soil of Japan. It may be regarded as religion, and yet if it be a religion it is certainly of a unique kind, having nevertheless much similarity to the ancient cults of the Greeks and the Romans. It has no founder, nor has it any dogmas, in the ordinary sense of a religion. It has grown up with the customs and traditions and general characteristics of the nation. It recognises the immortality of the soul; it acknowledges the existence of supernatural powers; it reverences the ancestral spirits, and therefore it may be called a religion of ancestral worship. In that respect it resembles Confucianism. It concerns itself, however, with temporal affairs far more than with spiritual affairs. In this respect also it very largely resembles Confucianism. It has existed in Japan from time immemorial, long before the introduction of Confucianism and Buddhism.

From an ethical point of view it has more teaching in it than Buddhism, but it is not so elaborate as Confucianism. Nevertheless, it has a tight grasp of the Japanese mind. It is supremely content with its simple tenets, so much so that a well-known scholar, who was a devout supporter of it, when speaking of its ethical teaching in comparison with Confucianism, once said that "We do not want so many nomenclatures as Confucianism requires to signify all sorts of virtues and good conduct, and our simple teaching is quite enough to cover all."

Shintoism is also based upon a patriarchal form of community. Its essential notion of ethics is cleanliness of conscience; but the idea of cleanliness is applied not only mentally but also physically—hence its tendency to bodily cleanliness as well as other cognate matters. It speaks of good and bad; it designates bad minds as "black" or "muddy," and good minds as "red" or "clear." Its ideals of conduct are honesty and straightforwardness. It reverences its ruler from the very nature of its cult, and a magnificent ideal of a subject and a citizen is developed from these simple notions.

Such are then the three great sources of Japanese ethics. It is like the foam produced by currents of water. The water is the source, but when foam is produced it differs from actual water. So Japanese ethics are produced by the intermingled notions of these agencies, but they are no longer of the same substance as their source. I mean to say that our ethics have formed their shape quite independently of the orthodox or dogmatic parts of any religion, and people regard them as such in the same way as one would ordinarily regard foam as differing from water. I will now explain how this has been brought about. From about the sixth century of the Christian era Chinese study was introduced into Japan, and almost simultaneously Buddhism was also introduced to our country. The study of Chinese, as I said before, means the study of Chinese ethics, and I may say that Chinese has become almost like our own literature, though we had our vernacular literature coexisting. The study of Chinese, therefore, meant the introduction of Chinese ethical notions, in the same way as the study of Greek or Latin introduced Greek or Roman notions into European countries. This, however, did not mean that it supplanted our own ideas of morality, but it rather supplemented and augmented our notions in so far as it concerned the nomenclature and classification of different ethical virtues. We did not mean to make ourselves slaves to Chinese notions, we rather utilised Confucianism; and therefore Confucianism, as interpreted in Japan, is not the same as Confucianism in China. There is a story told of a Japanese professor, who was a deeply-read Chinese scholar, and his pupils. The master once asked his pupils, "Suppose China invaded Japan with an army led by Confucius himself as the generalissimo, and assisted by Mencius as his lieutenant; what would you do?" The pupils replied, "It would be our bounden duty to take up arms unhesitatingly for our country and beat and crush them to pieces." Thereupon the master smiled and expressed

his glad assent. This will show how we interpret Chinese teaching. Then also Buddhism, poor as it is in ethics, has contributed something towards forming our national character, in that it has indirectly assisted in inculcating gentleness, and also kindliness to living beings. I may go a step further: Buddhism itself as interpreted in Japan is not the same Buddhism as it was originally. It had to accommodate itself to the requirements of the country. Then also Buddhism in China and Japan is studied in books which are translated into Chinese, and therefore the priests who study their own religion have also to study Chinese, which, I repeat, involves the study of Confucianism, and therefore they are familiar with that teaching. The Japanese priests, therefore, made use of Shintoism and Confucianism in their own teaching on any points where they found their own teaching was deficient, that is to say they did so in practical and moral teaching. And, not only that, we notice even the dictum of Buddhism itself is sometimes modified to suit such purposes. I mentioned above four benevolences spoken of in Buddhism as being "the father and the mother," "the ruler of the land," "all beings," and "the three treasures." I do not know whether this is to be found in the Sanscrit original, I think it is not, it sounds more like a Chinese Buddhistic notion. It is still further modified in an old Japanese book as "heaven and earth," "the ruler of the land," "the father and the mother," and "all beings." And thus for "the three treasures" is substituted "heaven and earth." This occurs in a passage which is put into the mouth of a famous Shigemori in a discourse which he made when he severely admonished his father Taira-no Kiyomori, though with filial tenderness, when the latter had behaved badly towards his sovereign the Emperor. The passage is to be found in a famous book written in the middle of the fourteenth century by Kitabatake Chikafusa, who was a court noble, a royalist, and a man with much knowledge of Buddhism.

Here I have to speak of Bushido. The term, as well as its general purport, has been of late made widely known in this country; but, as many people wish it, I will say something about it, although it may be only, as we say, "adding legs to the picture of a serpent," I mean it may be quite an unnecessary addition. Bushi literally means a military gentleman, or in more common English, a military man; and "do" literally means a road or way, and in its extended significance, a principle, a teaching, or a doctrine. The term for "Bushi" in old refined Japanese is "Mononofu," and the term for "do" is "Michi," therefore the more refined ancient Japanese name for Bushido was Mononofu-no-Michi. The origin of the "Bushi" is as follows:—They were originally large or small landlords of the provincial parts of Japan, and had their retainers or vassals. At the time when, in the court of the empire, over-refinement, or rather effeminacy, succeeded enlightenment, and nobles who usually resided in the capital came to despise military service, those landlords and their retainers began to play military *rôles* under different distinguished leaders. They were more prominent in the eastern parts of the country, called Kwanto, namely, the large plain, in the middle of which modern Tokio is situated. With the march of events, when the governing power fell into the hands of the military leaders, these landlords and their retainers began to form an hereditary class, and the system extended to the whole country; this is the origin of Daimio and Samurai. I do not say that in the case of later developments of this system all Daimio and Samurai necessarily belonged to the same ancient stock, because at the time when the country went through many stages of war many new men appeared on the scene and enlisted themselves in the ranks of the Samurai, among them the Bushi, several of whom became Daimios themselves by their personal valour and the distinction they attained. But I may say that on the whole the successive stages of the class always inherited and handed down the same sort of sentiments and notions as their predecessors. We may in a measure compare this military class with the country squires in this country, who gradually became barons of the middle ages, together with their children and retainers. "Bushido" is no other than the doctrine held and cherished by that class as its code of honour and rule of discipline. In the earliest days of the development of that class, individuals forming it were not cultured or enlightened in the sense of luxurious refinement; in other words, they were mostly illiterate. But on the other hand they were mostly men with healthy notions of manliness in contrast to those who usually lived in the capital town where literary and artistic culture under Chinese influence had been attained in a marked degree. The motive and sense of their culture were therefore more like those belonging to primitive

Japan, unstained by foreign influences. The families belonging to this class were called in their early days "the houses of the bow and arrow." Needless to say that the early projectile weapons of warfare were the bow and arrow, and they had a place of honour amongst the warlike instruments of those days. Little by little a phrase "yumi-ya-no-michi," literally meaning "the ways of the bow and arrow," came into existence, and it was the original name of Bushido. At first, perhaps, the word referred more especially to the proper use of the instrument of war, but it soon came to signify something more. There were many ceremonies and etiquettes which grew up with a warrior's life and military affairs, not only with reference to his comrades or to his superiors and inferiors, but also with reference as to how he should comport himself towards his enemy. At the bottom of all these matters there lay the idea of honour, not merely one's own honour, but also a compassionate regard for the honour of the enemy. All these ideas came to be implied in the term "the ways of the bow and arrow." Here we see that special moral sentiments were being awakened among this class. Bushido, however, has no particular dogma or canon, except such as grew from practice, and except those of which we can gather some idea from instructions given by certain leaders or by certain teachers of military ceremonies or science in the way of interpretation of such matters. Here we have an instruction given to his men by Yoritomo, the first Shogun, and therefore one of the early leaders of the system. The essential points of the instructions are these:—1. Practise and mature military arts. 2. Be not guilty of any base or rude conduct. 3. Be not cowardly or effeminate in behaviour. 4. Be simple and frugal. 5. The master and servants should mutually respect their indebtedness. 6. Keep a promise. 7. Share a common fate by mutual bondage in defiance of death or life.

We may say that notions such as these were the foundations of the ethical parts of Bushido. These will mean when interpreted in ethical terms of the Chinese school:—1. Diligence in one's profession. 2. Love and loyalty between master and servants. 3. Decorum and propriety. 4. Gallantry and bravery. 5. Trustfulness and justice. 6. Simplicity and frugality. 7. Contempt of meanness.

At the bottom of these lay the sense of honour. When speaking of any action as unworthy of a Bushi, the following phrase was customarily used in early days, "It is disgraceful in the presence of the hand of the bow and arrow," as in later days one would say "a disgrace to Bushi," in the same way as you would say in English, "it is unbecoming to a gentleman." The term "Bushi" has in many ways a similar meaning to "gentleman" in English. Bushido, of course, encouraged bravery above all things. In an old book describing the war between Gen and Hei, an account of the bravery of Bushi of Kwanto—namely, the plain above referred to as that where Bushido originated—is put into the mouth of a general of Hei as having been addressed to his generalissimo, who commanded the army of Hei, which was formed of recruits coming from Kioto and its neighbourhood. The narrative was to this effect:—"According to the usage of the warriors of the East, the son would not withdraw from the battlefield though his father might die, or the father would not think of retiring though his son might fall. He would advance and advance, and jumping over the dead, would fight regardless of death or life. As to our own men, they are all weakly recruits from the neighbourhood of the capital [where effeminacy reigned at the time]. If the father were wounded, the son and all the members of the family would take advantage of this and retire; if the master were killed, his followers would utilise the chance, and, hand in hand with their brothers, would withdraw and disappear." This may be a somewhat exaggerated account, but it will show how greatly the original Bushi estimated bravery, in the same way as our men do in these days.

In addition to these characteristics, some other features which were brought into more prominence are entitled to be singled out, namely, fortitude, generosity, imperturbability in the presence of danger or on any unexpected occurrence, compassionateness, and straightforwardness. This kind of attitude was inculcated even in physical exercises of different modes of fighting, such as fencing, practice with the spear, and jujitsu. There is a verse composed by a Japanese which may be translated thus:—

> Even in the eyes of the warrior
> Whose beard is ten fists long,
> The one thing that softly flows from them
> Is the tear which is due to love.

This aptly expresses the innate tenderness of heart of a Japanese warrior. There is another verse composed and penned by Commander Takeo Hirose in Chinese just before

he went to his doom on the occasion of the second bottling up of Port Arthur, and which, therefore, constituted his last utterance in this world; translated into English it runs as follows:—

> "Would that I could be born seven times
> And sacrifice my life for my country:
> Resolved to die, my mind is firm,
> And again expecting to win success,
> Smiling I go on board."

This will show the fortitude and determination of a Bushi at the hour of his exit from this life, and though Hirose was a man of our own day, he may be regarded as one of the best types of an old Bushi.

Bushi is not foreign to Shintoism; as a matter of fact, Bushi generally respect Shinto deities, and, moreover, some military ceremonies were performed in the supposed presence of a Shinto god. Bushi openly invoke the god of war without any compunction, but Bushi never have done so in a bigoted way. It was more in the way of reverence paid to a deity of their inherited cult. They were never devotees of Shintoism as a religion. This sort of sentiment of the Japanese is very difficult to explain with clearness, but my meaning is that though they do not despise religion they place more importance on the affairs of the world and on their own exertions in the matters which they undertake. The Samurai do not worship their deity in order that their souls may be safely rescued in the future. I can therefore say that Bushido, as such, has no bearing upon Shintoism. It has its own independent existence, although to the extent I have just referred to it has its connection with Shintoism. In other words Shintoism was a cult founded upon our old customs and traditions, and therefore Bushi also shared the sentiments pervading that cult, but we cannot say that Shinto has produced Bushido.

And again, Bushi do not despise Buddhism, on the contrary many of them may revere it, but Bushido, as such, has no connection with this faith. In documents they often make use of a phrase in a vague way, "by the help of Shin-Butsu," meaning both the Shinto deity and Buddha; but it does not mean that it has any foundation in Buddhism. If a Bushi were a believer in Buddha he probably would not like to show it. We have a story about Yoritomo, the first head of the Shogunate. When he first started in his youth his campaign against Hei, and hid himself in a mountain nook, having been defeated by his enemy he took out from his queue a small image of Kwanin (Kwannon) which he reverenced, saying, "if my head be taken by the enemy it would not be becoming to the generalissimo of Gen if this image were to be discovered." This will give you an idea of the way in which Buddha was viewed by Bushi. As we all know, Buddhism chiefly speaks of the future world. The idea of the Bushi was that it was an act of cowardice if one merely did good because one wished to be saved in the future world. Their idea was that good should be done for its own sake, and therefore if one believed in Buddha he had a sort of apprehension that he might be considered a coward. Of course history is not wanting in many instances of great warriors believing in Buddhism, but in many cases this fact had no great significance as far as their conduct and conscience were concerned. There was, however, one feature in which a certain aspect of Buddhism had a considerable influence in moulding Bushido; it was the influence of the teaching of the Zen sect. This requires some explanation. In the thesis of Buddhistic teaching there is included the idea of absorbing everything in the universe into oneself, in other words mental annihilation of all things except oneself. This is done by long and fixed meditation, and at least so far as he himself is concerned, a man can for the moment imagine and realise mentally that he is the only being in the universe, and all other things become nothing. Hence, when he is accustomed to meditation of that description, nothing will ever surprise or frighten him. There is a story about Hieuntsang, the famous Chinese Buddhist of the Tan period, who visited India. This priest was once caught by a band of robbers. He sat quietly down and began to meditate in the way described above. The robbers tried to intimidate him by threatening him with drawn swords pushed right into his face; but the priest took no notice whatever of what they were doing to him, and remained entirely unmoved. The robbers, observing the attitude of the priest, and thinking that he must be an extraordinary personage, all went away and left him alone. This phase of Buddhism was introduced into China, where it became the cult of one separate sect of Buddhism. Bodhi-Dharma, an Indian priest, who visited China, is commonly accepted as the founder of this sect, which practices meditation more than do other sects, but of course meditation is not its only feature. In general we may say

it is more philosophical in the sense of regarding the universe in a nihilistic sense. This sect is called Zen, and it has been introduced into Japan also. It was patronised by several eminent Bushi in its earlier stages. Perhaps it was liked by them in that according to its doctrine, a man puts aside the idea of reliance upon another, and places himself above every thing else, and it was found to have an agreeable resemblance to the spirit of self-reliance inculcated by Bushido. In the second place it repels all ideas of luxury and display and values simplicity and cleanliness, and in that respect it was found to bear an agreeable resemblance to the frugal and simple life of the Bushi. Thus the Zen came to exercise its influence over the Bushi, but not at all in the sense of believing in future felicity; quite to the contrary, from the very nature of that sect. This influence of Zen seems to have helped to a great extent the development of some of the characteristics of Bushido, such as imperturbability, stoicism, fortitude, and simplicity and cleanliness of thought or body. Here I may add that many traits of Bushido are no doubt to be found in the European knighthoods of former days, and therefore they are not really new to the Europeans who still remember those traditions.

The weakest point of Bushido in its earlier stages was its want of literary culture in the way of systematic ethical study, hence it easily happened that a thing one might regard as correct might not be correct in reality when examined from a higher point of view. This difficulty was especially observable when two obligations came into conflict, and one had to be preferred to the other. The Bushi, in the earlier stages, knew more about their duty to their immediate master than to higher ones; hence their difficulty in discerning their duty to the supreme ruler of the land and their immediate head. Of course, they knew that the Emperor was the highest personage in the country, but they were unable to find out an ethical solution of the question, and indeed in all matters they wanted more systematic enlightenment.

These wants, however, have been supplied gradually as time went on, especially during the last three centuries. During this period almost unbroken peace reigned in the country. It ceased to have any intercourse with foreign countries except in a limited sense, but internally all branches of art and industry were encouraged and developed side by side. The study of Chinese and of native classics have been carried out in all parts of the land, and it was the Bushi who chiefly devoted themselves to such culture. Bushi or Samurai were retainers, as everyone knows, of their lords, and certain pensions were given by their lords to each family, according to their rank, so that they had not to work for their own living. Hence their only duty was to make themselves physically and mentally fit to fight for their lords in time of necessity, and, in times of peace, to make themselves as much like gentlemen as possible. In other words physical training and mental enlightenment, together with the refinement of their manners and habits, were their sole business—they had no other occupation. For, indeed, any other occupation which partook of the shape of business conducted for profit was forbidden, and was despised among them. Bushido came to be deeply imbued with the principles of Chinese and Japanese classics as they were taught. I have shown above that in the systematic exposition of ethical ideas, Confucianism was the richest of all, and the essential part of it was taken by Bushido; as I have also shown above, there are many defects in the Chinese teaching; all the unimportant parts were cast away and the important parts were taken into the teaching of Bushido, and even these parts only in such a way as to suit our national traditions and characteristics, the essential spirit of Shintoism also being resuscitated in such a way as to give an impetus to Bushido, though in no orthodox manner. Such then is our Bushido. The Bushi formed the governing class of the Japanese society, and it may be said the educated class also, or in other words the Bushi may be called the gentry of the country. We can, therefore, say that Bushido was the ethics of Japanese society. In one way it may be said that Bushido, as such, was a monopoly of the military class, but in truth its spirit was not confined to this only; the literary study of Chinese, as well as of native classics, was not necessarily limited to the military class; hence the same notions which were imbued in it through these studies were also quietly extending their influence among people at large—amongst whom, I may add, there were many families of old Bushi, or families which were quite equal in their standing to the Bushi class. Moreover, the spirit of Bushido has also been making its influence felt by other people. Thus we can see that the nation has been preparing itself for centuries for the pro-

motion of moral ideas of the same kind as those of Bushido.

The cardinal points of Oriental ethics, as may be expected, are loyalty and filial piety. In China, filial piety takes precedence, but in Japan loyalty stands first. There is a poem by Sanetomo, the third Shogun of Kamakura and second son of the first Shogun, which may be translated literally as follows:—

"The sea may dry up,
The mountain may burst asunder,
But no duplicity of thought
Shall I have to my Sovereign."

Such is the idea of loyalty which has been taught to the Japanese for centuries. Side by side with loyalty the idea of patriotism—a term which in Japanese is almost identical in its purport with loyalty—was also inculcated, though the development of this last idea was later than the former. Then also all the other ideas relating to ethics, especially on the lines indicated in Confucianism, were inculcated side by side. With the abolition of the feudal system, some thirty years ago, the structure of Japanese society was totally changed, or rather restored to the condition which preceded the ascendency of the military class in the twelfth century. The question now arises, what is the actual state of ethics in Japan at present? There is a new element which has been introduced into Japan in recent years, and it is in the form of Christianity. The constitution guarantees freedom of conscience, and therefore there is no hindrance to the propagation of the Christian doctrine with its moral teaching, and, as a matter of fact, there are a number of Japanese who have embraced that faith, but they are after all a very small minority compared with the number of the whole Japanese population. The essence of Japanese ethics is the same as existed prior to the new epoch, with certain modifications actuated by the new force of the altered conditions which, after all, are only in small details. I may say, in a word, that the Japanese ideal ethics form an extension of Bushido among the people at large from the non-extinct class of Bushi with whom it originated. As to how they stand at present, and how they are inculcated among the people at the present time, I must refer my audience to an article entitled "Moral Teaching of Japan," which was contributed by me to the February number of *The Nineteenth Century and After*. The sphere of the teaching is extensive, as is necessary from the very nature of the matter, but its essence may be summed up in a comparatively small compass. For this I cannot do better than quote a part of the so-called "Imperial Educational Rescript" given to his people by the present Emperor. It is quoted in my article to which I have just referred, but I will recite it once more:—

"It is our desire that you, our subjects, be filial to your parents and well-disposed to your brothers and sisters. Let husband and wife dwell harmoniously together; let friends be mutually trustworthy. Impose upon yourselves self-restraint and rectitude of behaviour. Extend to the multitude philanthropy. Advance learning and regulate your pursuits, developing the intellectual faculties and perfecting the virtuous and useful elements. Further, seek to enhance the public good and enlighten the world by deeds of social benefit. Treasure always the fundamental constitution and respect the national laws. In any emergency exert yourselves in the public service, and exhibit voluntarily your bravery in the cause of order. And by every means assist and promote the prosperity of the Imperial *régime*, which is lasting as the heavens and the earth. Thus you will not only be our loyal subjects and good citizens, but will manifest the highest and best traditions of your ancestors."

Such then are the essential phases of the ethics of Japan. They may be far from reaching your lofty ideals and expectations, but we are contented with their general tendency, while at the same time we do not forget to inculcate the necessary furtherance and expansion of our ideas required by the changing circumstances of the time. We are likewise mindful of the desirability of carrying them out in such a way as not to conflict with the best ideals of any other country, for our sole aspiration is to preserve harmonious relations with the whole of mankind.

DISCUSSION.

The CHAIRMAN, in proposing a cordial vote of thanks to the author for his very able and interesting paper, said he was sorry to say that a great many years, more than he cared to recollect, had passed since he first became acquainted with Baron Suyematsu's noble country. In those days very little was known about Japan. People knew that somewhere in the Far East there was a country which produced lovely works of art, and which they were told was unrivalled for its scenery. They knew it was called the land of the Rising Sun; now he thought they could call it the land of the Sun that had risen. If people in those days knew very little about Japan, on

the other hand Japan knew still less about the West. Japanese gentlemen did not travel as they did nowadays; they remained at home; and he believed there was actually a law which prescribed that any Japanese who left his own country and travelled in foreign countries should, for that very reason, be executed when he returned home. All that had changed. They now stood lost in admiration before a country which had proved itself to be one of the greatest nations of the world, although it was so short a time since it first entered the community of nations. The paper had been one of great interest to him personally, because it had described many of the elements which had gone to form the Japanese character, a character which Englishmen had learned to-day to look upon as the very essence of all that was noble and chivalrous. Baron Suyematsu had said a good deal about the Bushido, which meant the path, or religion or teaching of the Bushi. The author had stated that the word "Bushi" might well be translated by the word "gentleman." He did not think a better translation of the word could have been found, for all that Englishmen looked upon as going to form the highest and noblest conception of what they meant when they used the word gentleman was conveyed by the word Bushi. It was loyalty to the Sovereign, trustfulness to the friend, truth, honour, courage and chivalry. If proof was wanted that chivalry was of the very essence of Bushido, what could be found better than that magnificent message which was sent by the Emperor himself after the taking of Port Arthur, when he told his soldiers to respect General Stoessel, who had done such good work for his own country. He thought that message of the Emperor of Japan, coming as it did at that particular moment, would live in history and never die. In the earlier part of the paper, the author had stated that the Chinese word "jen" might be translated love, but Baron Suyematsu confessed that the translation had given him some difficulty. He suggested to the author that the best translation of the word "jen" was Charity in the Pauline sense of the word — when St. Paul said "The greatest of these is Charity;" and if Baron Suyematsu would in future use that translation of the word, he did not think he would find any more difficulty. There was one remark in the paper which seemed to him to be pregnant with meaning. The author had stated that Chinese histories gave a bare record of facts, and had implied that they showed no political bias. That was perfectly true; and he had often wondered to himself whether it would not be better that some of the English histories should follow that example, and thereby get somewhere nearer to the truth of many events which had taken place in the past. Such confused and contradictory versions were at present obtained that people were hardly able to form any estimation of the truth. Shintoism, as the author had pointed out, was the aboriginal religion of Japan. He thought Baron Suyematsu would perhaps agree with him in saying that he might have gone one step further in defining it, by saying that it was indeed a form of Sun worship, coupled with the respect of ancestors. Worship of the Sun he believed formed an essential part of the more ancient forms of Shintoism; the whole of the fable of the Sun God, his hiding in the cave, and other of the original fables of the Japanese cosmogony all pointed in that direction. He thought the audience might congratulate the author on the great achievement of his fellow-countrymen which had been recorded within the last few hours. It might be said without exaggeration that those living in the present day were the witnesses of one of those crises which made a profound mark upon the history, not of one or two countries, but of the whole world. The successes they had heard of that day had been achieved in the face of difficulties of which those present could probably form no idea. The armies that were opposed to one another were the largest armies that had ever stood face to face since the history of the world began. The line of operations was 75 miles in length, 15 miles further than the distance between London and Oxford; and that those operations should have been successful, not in one nor in two parts, not in one corner nor in another corner, but along the whole extended line of 75 miles was a military achievement which had not its parallel in the history of the world.

The resolution of thanks, having been carried,

Baron SUYEMATSU, in reply, briefly acknowledged the compliment.

CORRESPONDENCE.

COTTON GROWING IN THE WEST INDIES.

In the *Journal of the Society of Arts* for February 13th, 1905, pp. 198-9, there is a note on "Cotton Growing in the West Indies." As this note is likely to give a wrong impression to readers as to the present position of efforts to resuscitate the cotton industry in the West Indies, I would desire to point out that the information contained in it is now obsolete.

The note is based, it is stated, on a report issued by the Colonial Office, but no hint is given of the fact that this referred to the year 1903, and cannot, therefore, contain the most recent information on the subject.

Since the expiration of the period under review in the note, considerable progress has been made in connection with cotton growing, full information in respect of which has been published in the *Agricul-*

tural News and the *West Indian Bulletin.* Copies of these are regularly communicated as issued.

I would quote the following extract from the presidential address delivered by me before the West Indian Agricultural Conference held at Trinidad on January 4–12 last. This contains the latest information in regard to cotton growing in the West Indies.

"The first of the recent experiments in cotton growing were started at St. Lucia in 1900. In the following year these experiments were extended to Barbados and the northern islands. In 1902 Messrs. Stendall and Wade began the cultivation of cotton on a commercial scale at St. Kitt's and Montserrat. The total area planted in all the islands in 1902 was 500 acres. This was increased in 1903 to 4,000 acres. During the year 1904 the area planted in Sea Island cotton, and now coming into bearing, was 7,243 acres, and in other varieties 4,438 acres, making a total of 11,681 acres. Valuable assistance was rendered by the British Cotton-growing Association in making grants of money and machinery; also in taking charge of the shipments of cotton and finding the best market for them. More recently the Association arranged for a visit to the West Indies by Mr. E. Lomas Oliver who rendered great service by explaining in detail the requirements of spinners in regard to uniformity in length of staple, colour, and fineness. The Imperial Department of Agriculture supplied 35,700 lbs. of seed of the best variety of Sea Island cotton at cost price. At present there are fifteen well-equipped cotton ginneries in working order. The prices obtained for West Indian Sea Island cotton during the past season have ranged from 12d. to 18d. per pound. The average price was 14½d. per pound. It is now recognised that West Indian Sea Island cotton is an article in good demand, and the industry shows every promise of being established on remunerative lines. It is probable that the crop of Sea Island cotton to be reaped from now to May next will reach about 5,000 bales (of 300 lb. each), of the value of £100,000. Details in regard to the general position and prospects of the cotton industry will be laid before the Conference.

D. MORRIS,
Commissioner of Agriculture for the West Indies.

Barbados,
February 2nd, 1905.

STREET TRAFFIC.

A few weeks ago (see *ante* December 30, 1904, p. 145) I saw some remarks in the *Journal* about wheeled traffic going along the left side of the road and foot traffic along the right side of the path, but I did not notice that anyone gave what is probably the real reason for the maintenance of that custom—namely, that it is more convenient in practice for the foot and wheeled traffic going the same way to be next one another.

C. F. WALSH.

OBITUARY.

HENRY LEE, J.P.—Mr. Henry Lee, who died at his house at Broughton-park on December 27th last, had been a member of the Society of Arts since 1872. He was the son of Mr. Lee Lee, a muslin manufacturer, and was born in 1817 at Chorley. He was apprenticed to Mr. Goodair, of Preston, a cotton manufacturer. Afterwards, when in partnership with Messrs. Tootal, he established the Sunnybank Cotton Spinning and Weaving Mills near Bolton, and became a pioneer in the application of steam power and automatic machinery to the production of fine and fancy fabrics of high quality. Mr. Lee was also a director, and for several years chairman, of Bolckow, Vaughan, and Co, Ltd., of Middlesborough, director of the Manchester and Salford Bank, and director and chairman of the Manchester Chamber of Commerce. He established schools for the benefit of the children of his workpeople, which were continued for more than 20 years after the passing of the Elementary Education Act of 1870. He was a member of Parliament for Southampton from 1880 to 1885, and throughout his life took the greatest interest in the education, promotion of thrift, and general improvement of the working classes.

G. J. MORRISON.—Mr. Gabriel James Morrison, M.I.C.E., who died on February 11th at the age of 65, was a member of the Society of Arts, and in May, 1903, he read a paper on "The Construction of Maps and Charts," for which he received the Society's silver medal.

The following particulars of Mr. Morrison's career in China are taken from the obituary notice in *The Times*:—He was a favourite pupil of Sir William Thomson (now Lord Kelvin), and was present with him at the laying of the first cable across the Atlantic ocean. He went out as engineer-in-charge of the first railway laid down in China. This railway ran between Shanghai and Wusung, and was very soon torn up by the Chinese Government, the materials being shipped over to the island of Formosa, where they were allowed to rust away. Mr. Morrison then established himself in business in Shanghai as a civil engineer, making frequent trips to Peking and into the interior of China, visiting officials and endeavouring to get a system of trunk lines laid. In 1885 he entered into partnership with Mr. F. M. Gratton, and the firm of Morrison and Gratton, as civil engineers and architects, was for many years connected with the largest and most important works carried out at Shanghai. The partnership was dissolved in 1902, when Mr. Morrison came to London and was associated with Sir John Wolfe Barry and Mr. Arthur J. Barry as consulting engineer of the Shanghai-Nanking line. During his residence in China he took a deep interest in public affairs and was for many years a member of the Shanghai Municipal Council, and major in command of the Shanghai volunteer corps.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MARCH 15.—"Methods of Design in Mohammedan Art." By E. H. HANKIN. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

MARCH 22.—"The Present Aspect of the Fiscal Question." By SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B.

MARCH 29.—"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P. R. C. MUNRO-FERGUSON, M.P., will preside.

APRIL 5.—"Ancient Architecture of the Great Zimbabwe." By RICHARD A. HALL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 16.—"Manipur and its Tribes." By T. C. HODSON (late I.C.S.).

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

HERBERT LAWS WEBB, "Telephony." Four Lectures.

LECTURE I.—MARCH 13.—*Telephone Instruments.*—The telephone industry—The Bell telephone—Telephone receivers—Telephone transmitters—Evolution of the modern transmitter—Design of transmitters and receivers—Signalling appliances—Complete telephone instruments—Protective appliances—Special forms of telephones—Special uses of the telephone.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Herbert Laws Webb, "Telephony." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. E. Morten, "Surveyors' Reports and Certificates."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 14...Aeronautical (at the HOUSE of the SOCIETY OF ARTS, John-street, Adelphi, W.C.), 8 p.m. 1. Mr. P. Y. Alexander, "Some Recent Experiments in Aerodynamics." 2. Mr. Eric Stuart Bruce, "The Shape of Navigable Balloons." 3. Mr. E. C. Hawkins, "Automatic Stability." 4. Mr. Alan A. Burgoyne, "Note on an Aluminium Kite."

Hellenic (in the Society of Antiquaries Rooms, Burlington-house, W.), 5 p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Professor Pearson, "Some Recent Brometric Studies." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Lord Brassey, "Shipbuilding for the Navy."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. S. D. Chalmers, "Some Results of Lens Testing."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Sir Charles Bruce, "The Crown Colonies."

Horticultural, Vincent-square, S.W., 3 p.m. Rev. Prof. Henslow, "Bud Variation."

WEDNESDAY, MARCH 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. E. H. Hankin, "Methods of Design in Mohammedan Art."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Mr. Richard Bentley, "The Growth of Instrumental Meteorology." 2. Exhibition of Meteorological Instruments.

Chemical, Burlington-house, W., 5½ p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Mr. J. E. Stead, "A Review of Work done by Metallographers."

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Mr. T. B. Simmons, "Housing of the Working Classes."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, MARCH 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. T. C. Hodson, "Manipur and its Tribes."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Otto Staff, "Contributions to the Flora of Liberia." 2. Mr. Rupert Vallentin, "Penguins and other Birds from the Falkland Islands; and Scratched Rocks from a Rockhopper's Rookery."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. H. H. Turner, "Recent Astronomical Progress." (Lecture III.)

Optical, 20, Hanover-square, W., 8 p.m. Presidential Address.

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 17...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m., Sir Squire Bancroft, "Dramatic Thoughts: Retrospective—Anticipative."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Prof. David S. Capper, "First Report of the Steam-engine Research Committee."

SATURDAY, MARCH 18...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Electrical Properties of Radio Active Substance." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 20, 8 p.m. (Cantor Lecture.) HERBERT LAWS WEBB, "Telephony," Lecture II.

TUESDAY, MARCH 21, 8 p.m. (Applied Art Section.) F. BLIGH BOND, F.R.I.B.A., "West Country Screens and Rood Lofts."

WEDNESDAY, MARCH 22, 8 p.m. (Ordinary Meeting.) SIR CHARLES MALCOLM KENNEDY, K.C.M.G., C.B., "The Present Aspect of the Fiscal Question."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The number of entries for the Society of Arts Commercial Examinations to be held next month amount to 25,957, an increase of 4,367 on the numbers of last year—21,590. This total is made up as follows:—Advanced Stage 5,435, Intermediate 11,329, Elementary 9,193. The number of centres at which this year's examinations will be held is 383. Last year there were 346.

CANTOR LECTURES.

On Monday evening, March 13, Mr. HERBERT LAWS WEBB delivered the first lecture of his Course on "Telephony."

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

On Thursday afternoon, March 16; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The paper read was "Manipur and its Tribes," by T. C. HODSON (late I.C.S.).

The paper and report of the discussion will be published in a future nnmber of the *Journal.*

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1905 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 1st April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of

food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of our several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (afterwards Sir) Henry Doulton, "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (now Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry—the utilisation of waste silk."

In 1887, to HER MAJESTY QUEEN VICTORIA, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce, through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring

matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by the application of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries by which not only has the art of surgery being generally promoted, and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches and the resulting development of the iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3,000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S., "in recognition of his numerous and most valuable applications of Chemistry and Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics; researches which have, in many instances, developed into useful practical applications in the Arts and Manufactures."

In 1900, to Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and for its application to the production of the electric search-light, and to the electro-deposition of metals from their solutions."

In 1901, to HIS MAJESTY THE KING, "in recognition of the aid rendered by His Majesty to Arts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country and the executive control of British representation at International Exhibitions abroad and also by many other services to the cause of British Industry."

In 1902, to Professor Alexander Graham Bell, "for his invention of the Telephone."

In 1903, to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over 44 years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal."

In 1904, to Walter Crane, "in recognition of the services he has rendered to Art and Industry by awakening popular interest in Decorative Art and Craftsmanship, and by promoting the recognition of English Art in the form most material to the commercial prosperity of the country."

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, February 28th; the Right Hon. VISCOUNT RIDLEY in the chair.

The CHAIRMAN said as one who had spent a certain amount of his time, and not, he might say, the least pleasant part of his time, in Canada, he had very great pleasure in taking the chair that afternoon. Ever since his connection with the country his interest in the affairs of the Dominion had been unceasing. He thought that all would be agreed that the Society of Arts, in arranging a series of papers, of which the present one was the first, upon the industries of our colonies, was performing a very great service. He thought it was a strange thing that England did not take a more active interest in the affairs of the Empire. However, without touching upon that dangerous subject, the Fiscal question, he thought he might say, with the agreement of everybody, that at the present moment attention was being very considerably fo-

cussed upon the position of the colonies and their industries, and that papers such as the one about to be read were of very great value in disseminating information on and stimulating interest in the subject.

The paper read was—

THE MANUFACTURES OF GREATER BRITAIN.

I.—DOMINION OF CANADA.

By C. F. Just.
Canadian Government Service, London.

It is impossible to overrate the value of the educational work carried on for many years by the Colonial and Indian Sections of the Society of Arts. To a student of the British Empire a review of that work forms a useful index to the widening of knowledge and interest in our Colonies which has taken place in the Mother Country. General papers on the Colonies have had their day, and have yielded place to treatises on special colonial characteristics and interests, phases of life and progress, economic and political. In this respect the present series of papers marks a fresh departure in the education of our fellow subjects at home in the progress of the outlying portions of the Empire. There is no need, therefore, to speak of Canada in general terms. Her agricultural development is well known—it has become the envy of the world; her forests and fisheries are exploited on an unexampled scale; her mineral wealth, while as yet hardly touched, is known to be vast, and is to be the reward of enterprise in the immediate future. Few, however, even of the best instructed, think of Canada except as a rich storehouse of products of the soil, the forest, mine, and stream.

My theme this afternoon is Canada's manufacturing industries. Canada is unquestionably the most advanced industrially of the self-governing colonies. The popular view here is that at best Canada's manufacturing resources are as limited as her population is limited—I hope to show you the contrary—least of all is the idea entertained of her future as a competitor with other countries in great industrial tournaments; and yet nothing less than this is certain within the immediate future. Living alongside the most progressive and industrial nation of the world, Canadians have seen what manufactures can accomplish in the building up of the State within a short span of time; they have rightly felt that, with no meaner country than that of their neighbours, the same industrial destiny must be theirs in good time, and, as events are proving, rather sooner than later.

The stirring of national life, which found practical expression in the Act of Confederation in 1867, fed the natural desire of Canadians to become a self-contained modern State. The refusal of the United States to renew the Reciprocity Treaty (1855-66), under which a large trade had been built up in that market, hit Canadian interests hard; new outlets had to be found for their products, but it served only to strengthen the resolve of the people for economic independence. A period of ten years' depression followed. It was accentuated by the high-tariff policy of the United States, with its corollary of dumping surplus production on the Canadian market, to the great disadvantage of the Canadian manufacturers struggling to build up local industries. In Canada this period was also one of experiments in low revenue tariffs, which, for reasons of self-defence, it was found necessary to increase from time to time.

A National Policy.

Circumstances at length brought the tariff policy of the country to an issue. Canadians had to deal with an actual condition, not a theory, and they decided ultimately to adopt a tariff which would protect and foster home industries, as set forth in the famous resolution moved by Sir John Macdonald in the House of Commons in 1878:—

> "That this House is of the opinion that the welfare of Canada requires the adoption of a national policy which, by a judicious readjustment of the tariff, will benefit and foster the agricultural, the mining, the manufacturing, and other interests of the Dominion; that such a policy will retain in Canada thousands of our fellow countrymen now obliged to expatriate themselves in search of the employment denied to them at home, will restore prosperity to our struggling industries now so sadly depressed, will prevent Canada being made a sacrifice market, will encourage and develop an active inter-provincial trade, and moving, as it ought to do, in the direction of a reciprocity of tariffs with our neighbours, so far as the varied interests of Canada may demand, will greatly tend to produce for this country eventually reciprocity of trade."

This national policy, broadly speaking, has held the field from that day to this. Its

expediency has been confirmed under the ceaseless aggressive high-tariff policy of the United States of the last three decades, which, under the McKinley and subsequent tariffs, was framed with special reference to Canadian primary and other industries competing with their own. Canadian endurance was tried in the fire. The situation called for the complete readjustment of Canada's markets. Canada's salvation was found to lie in developing her market in the Mother Country, which offered stable conditions of trade; these she could never expect to enjoy from the United States. The results have secured for her both a great permanent increase of trade, and have made her economically independent of the United States. To-day, trade depressions and financial crises across the frontier no longer seriously affect business in the Dominion. Canada also has incidentally more than regained the volume of her trade exchanges even with the United States, with this improvement, that this trade is now on a footing which it is possible for Canada to control and regulate to her advantage as circumstances may dictate. But I am anticipating. The National Policy brought great and immediate industrial activity in its train; the Canadian home market received at once the benefit of the vast expenditure on the Canadian Pacific Railway and other public works, and of the rapid settlement of the new prairie *hinterland* thrown open by railways to fresh immigrants.

The Census of 1881 already reflects this growth of Canada's industrial position. It was roughly double that of 1871 in the capital invested, the wages paid, the persons employed, and in the consumption of home-manufactured products. A number of causes, however, conspired to retard the expansion in manufactures that was expected. Among them must be mentioned the check to settlement in the West due to restrictive measures imposed in Europe on emigration, to the results of wild land speculation in the West which was very general, to the disturbances which led to the North-West Half-breed Rebellion of 1885; and, above all, to the continued drain of the native-born population to the United States, now happily at an end. It is not generally known in this country how serious this drain has been in the past, but an estimate of 3,000,000 people of Canadian origin and of their descendants living in the United States would not be wide of the mark. This fact alone explains the need of the opening up of Western Canada for settlement, and of developing the industries of the country to attract and retain population in the Dominion. It is also now recognised that inexperience of the working of economic conditions, imprudent additions to the tariff, threw burdens upon industry which hampered enterprise; nevertheless, the progress of manufactures shown in the Census of 1891, and again of 1901, must impress every thoughtful person with the enterprise of Canadian captains of industry, and the increasing diversity and importance of industrial production in the Dominion.

With the advent to power of the Laurier Ministry in 1896, important readjustments of the tariff took place. The anachronisms referred to were pruned away, and relief was granted in a multitude of cases. Industry at once responded to the change. Great advantage also, political and economic, attended the introduction of the British preference policy. In Canada its effect was to cheapen the cost of living all round—as the rebate on British imports influenced the prices of American imports and of home-made articles—and to leave in the pockets of the people millions of dollars for useful expenditure. Employment became and has remained most active ever since, and the sufficiency of the new tariff policy has been epitomised recently by the *Toronto Globe* in the comment, "that the supply of labour has been found *inadequate* is the best proof that the tariff is *adequate*."

Simultaneously with the year 1896 commenced that extraordinary improvement in Canada's position which has continued up to the present time, the end of which we believe to be still far off. The drain of population to the United States has ceased; immigration has poured into the country in a fertilising stream. The increase in population during this period has been estimated recently by Sir Richard Cartwright at no less than 1½ millions. Trade and commerce has doubled (1896, 231,601,000 dols.; 1903, 459,640,000 dols.); the revenue has doubled (1896, 33,978,000 dols.; 1904, 66,037,000 dols.), providing surpluses aggregating some 40,000,000 dols. in eight years. The Public Debt has not only been reduced, but large expenditures on remunerative public works have been met out of surplus revenue without adding a shilling to the burdens of the tax-payer. The general manager of the Canadian Bank of Commerce, speaking at the annual meeting in January last on the general position of the country said:—

"During the last ten years the business of banking in Canada has increased as much as in the preceding *eighty years*. The deposits of the people have not merely grown enormously in the aggregate, but they have grown from 52 dols. 16 cents to 99 dols. per head of population."

CENSUS RETURNS.

In no direction has the improvement been felt more than in Canada's manufacturing industries. The following Table shows the statistical position of their growth by 1901 compared with 1891 and 1881, and the distribution of the industrial establishments (1901) *by Provinces*:—

1. Consolidation, shown in decrease (11 per cent.) of the number of establishments of five *employés* and over.

2. Great increase of capital invested (48·83 per cent.).

3. Not a corresponding increase in value of products per dollar of capital (1901, 1·03; 1891, 1·21 per dollar).

4. Decrease in average wage (5·04 per hand per annum).

5. Increase in value of product per *employé* (14·76 against 13·34 in 1891.

During the four years that have elapsed, Canada's industrial progress has moved at such a greatly accelerated pace as to make the figures of 1901 no longer reliable. An authoritative writer on the subject, in the *Toronto Globe* of July last, estimates the manufacturing position to-day at 15,000 factories, representing invested capital of 500,000,000 dols., producing goods of a like amount, and employing half a million of people. It is now estimated that 40 per cent. of Canada's population, taken at six millions, is dependent upon her manufacturing industries. (See Table B, p. 446.)

	1881.	1891.	1901.*
Capital Invested	$165,302,000	$296,350,000	$441,353,060
Value of Products	$309,676,000	$359,082,000	$452,775,771
Number of Establishments............	—	12,404	11,126
Number of Employés	254,935	269,093	306,694
Wages Paid	$59,429,000	$78,492,345	$88,143,472
Average Wage.......................	$254	$292·44	$287·40

* It should be observed that the figures of the last two censuses refer to *manufacturing* industries only, and that the basis of enumeration excludes all industrial establishments employing under five hands. The figures of 1881 are on the old basis—*i.e.*, they include such industries as dairy factories, abbatoirs, &c., and *all* establishments affording industrial or hand employment, *however small*.

Provinces.	Number of Establishments.	Capital Invested.	Cost of Materials.	Value of Products.
		Dollars.	Dollars.	Dollars.
British Columbia	392	22,901,892	7,246,684	19,447,778
Manitoba	324	7,539,691	7,955,504	12,927,439
New Brunswick	919	20,741,170	10,814,014	20,972,470
Nova Scotia	1,188	34,586,416	13,161,077	23,592,513
Ontario	6,543	214,972,275	138,230,400	241,533,486
Prince Edward Island......	334	2,081,766	1,319,058	2,326,708
Quebec	4,845	142,403,407	86,679,779	158,287,994
The Territories............	105	1,689,870	1,121,342	1,964,987
Totals for Canada*	14,650	446,916,487	266,527,858	481,053,875

* Including dairy factories.

In Table A (p. 445) will be found an analysis of the comparative position in 1891 and 1901 of the Canadian manufacturing industries classified by *groups*, from which a useful survey of the diversity of the manufactures and the relative importance of each respective branch can be obtained.

The Dominion statistician summarises his conclusions in regard to the Census of 1901* as follows:—

* Statistical Year-book of Canada, 1903.

TABLE A.—MANUFACTURES OF 1891 AND 1901, CLASSIFIED AND COMPARED.

Groups.	Number of establishments.	Capital.	Number of employees.	Wages.	Value of Products.
		Dols.		Dols.	Dols.
Arms and ammunition, 1891	14	928,356	501	190,547	977,255
,, ,, 1901	14	1,675,675	611	210,273	1,054,000
Books and stationery, 1891	418	10,074,520	9,187	3,631,337	9,769,963
,, ,, 1901	519	17,235,971	10,724	4,284,139	13,796,151
Carriages, &c., 1891	404	8,177,913	10,070	4,102,089	15,889,364
,, 1901	409	14,941,702	14,453	6,065,065	19,420,999
Chemicals, 1891	123	3,410,747	1,776	632,331	3,739,219
,, 1901	120	5,710,843	2,259	787,723	6,368,743
Drinks and stimulants, 1891	328	23,377,134	9,596	3,247,998	27,169,167
,, ,, 1901	384	39,340,286	11,275	3,970,859	36,034,328
Fibrous materials, 1891	88	3,213,442	2,632	560,785	3,168,821
,, 1901	79	3,901,905	2,621	574,171	4,211,806
Foods (animal), 1891	941	6,101,819	22,758	1,840,069	12,009,070
,, 1901	1,218	13,896,363	18,030	2,094,538	31,951,369
Foods (vegetable), 1891	600	22,308,422	10,010	2,901,192	40,876,766
,, 1901	793	24,781,251	15,705	3,650,356	47,492,461
Furniture, houses, and buildings, 1891	1,077	19,231,497	18,674	6,657,468	27,070,391
,, ,, 1901	888	22,409,724	17,163	5,167,252	24,988,932
Gold and silver, 1891	62	2,581,540	1,059	458,570	1,958,109
,, 1901	54	2,260,430	1,544	633,273	2,491,622
Leather, boots and shoes, 1891	557	14,186,586	16,020	4,864,737	24,364,469
,, ,, 1901	439	21,558,894	19,332	6,082,431	34,853,019
Lighting, 1891	118	19,824,968	3,642	1,161,601	6,606,549
,, 1901	132	27,632,868	8,810	2,040,689	11,317,374
Machines, tools, and implements, 1891	1,106	44,674,648	33,507	13,328,783	48,281,430
,, ,, 1901	969	77,712,502	38,923	15,424,844	91,636,978
Matters (animal), 1891	71	1,428,670	1,186	429,936	2,846,375
,, 1901	63	3,085,130	1,364	431,879	3,325,159
Matters (vegetable), 1891	2,740	64,553,220	59,132	16,401,323	63,591,644
,, 1901	2,469	84,319,298	66,475	15,611,996	71,713,699
Mathematical, &c., instruments, 1891	4	27,000	26	9,200	37,800
,, ,, 1901	4	115,700	140	47,136	199,750
Musical instruments, 1891	50	2,337,707	2,124	941,013	3,292,718
,, 1901	46	4,290,847	2,669	1,096,309	3,380,727
Ships and boats, 1891	162	2,182,201	3,420	1,080,753	3,356,259
,, 1901	60	3,503,434	2,744	866,695	2,291,668
Stone, clay, and glass, 1891	732	7,639,231	11,370	3,246,754	9,075,092
,, ,, 1901	677	7,117,245	9,370	2,335,592	5,820,544
Textile fabrics and dress, 1891	2,727	39,445,118	51,553	12,600,335	54,336,936
,, ,, 1901	1,648	55,792,164	62,705	14,885,366	62,035,654
Miscellaneous, 1891	82	644,877	841	205,525	665,230
,, 1901	141	2,770,828	3,777	1,182,866	8,390,594
Total, 1891	12,404	296,350,316	269,093	78,492,345	359,082,639
,, 1901	11,126	441,053,060	306,694	88,143,472	452,775,577

TABLE B.—For the Immediate Purposes of the Reader the following List is given of the Principal Manufacturing Industries, and of their Output in 1891 and 1901.

Name of Industry.	1891. Number of Establishments.	1891. Value of Products.	1901. Number of Establishments.	1901. Value of Products.
		Dols.		Dols.
Agricultural implements	95	7,252,005	114	9,597,386
Boilers and engines	42	2,433,878	59	4,626,214
Boots and shoes	269	12,706,215	179	18,481,215
Bread, biscuits, and confectionery	269	8,374,306	258	11,637,808
Brick, tile and pottery	520	3,701,721	573	3,299,017
Bridges, iron and steel	6	728,075	6	1,693,000
Brushes and brooms	33	763,985	28	952,658
Carriages and waggons	367	5,942,559	349	6,650,912
Cement (Portland)	11	227,275	7	872,876
Clothing, men's	1,373	18,669,652	735	8,775,439
Factory product	—	—	58	8,980,291
Men's furnishing goods	56	2,683,200	52	4,623,652
Clothing, women's	768	4,931,779	334	4,368,380
Factory product	—	—	26	2,190,627
Dressmaking and millinery	768	4,931,779	360	6,589,207
Hosiery and knitted goods	467	1,711,785	52	3,857,579
Cotton mills	22	8,451,724	20	12,033,052
Dyeing and finishing	—	—	3	2,051,992
Fruit and vegetable canning	39	866,142	56	2,831,742
Fish, preserved	805	5,661,144	1,097	8,025,030
Flouring and grist mills	230	30,721,846	400	31,835,873
Furniture and upholstered goods	234	6,025,811	169	6,949,384
Furriers and hatters	114	4,763,888	115	5,876,467
Iron and steel products	—	—	29	6,912,457
Foundries and machine shops	363	15,356,052	315	15,292,445
Leather, tanned and finished	170	9,711,781	143	12,068,600
Harness and saddlery	104	1,343,673	95	3,427,255
Lumber products	420	13,443,802	467	10,754,959
Meat curing and canning	62	5,661,144	57	22,217,984
Musical instruments	49	3,263,218	39	3,023,730
Oil refineries	43	2,128,112	14	3,519,493
Painting and glazing	75	1,089,620	5	103,000
Paper and cardboard mills	32	2,570,722	31	4,527,776
Patent medicines	14	421,100	35	1,350,993
Plumbing and plumbers' supplies	312	5,658,250	258	7,375,541
Printing and bookbinding	66	1,966,953	84	2,748,356
Printing and publishing	349	7,672,313	419	10,319,241
Rolling stock	18	7,546,644	26	9,450,525
Street car works	1	13,000	5	3,954,172
Rubber goods	9	2,040,000	7	1,574,422
Saw mills	1,921	44,443,571	2,075	50,805,084
Ships and repairs	132	3,087,475	39	1,899,836
Smelting works	15	3,016,200	12	7,082,384
Soap and candles	30	1,909,390	23	2,143,945
Sugar refining	7	11,627,100	4	12,595,900
Tobacco, chewing and smoking	31	2,347,650	22	6,469,961
Tobacco, cigars	93	3,280,114	138	5,332,151
Wire works	20	1,884,100	29	2,030,465
Wood pulp	23	1,053,842	25	4,246,781
Woollen goods	213	7,845,386	157	7,359,541
Watchmaking and jewellery	50	1,416,609	39	1,714,153

DIVERSITY AND WIDE DISTRIBUTION OF INDUSTRIES.

Looking closely into this Table, we recognise how successfully Canada has provided herself with the great basic industries of a modern State, and with a multitude of important subsidiary industries, so that there is scarcely an article connected with these great fields of manufacture which is not made well and cheaply in Canada. Obviously, Canada's manufacturing industries are almost entirely situated in the eastern half of the Dominion. A striking feature also is their wide distribution throughout that region, carried on in a multitude of generally small centres, of which they form the *raison d'être*. This distribution is possible owing to the general distribution of raw material necesssary for the industries, to the supply of cheap power, and transportation facilities by water and rail which permit the cheap assembling of material, and the distribution of the finished product to the home market and for export. This situation in a country of great distances is highly favourable to the success of industrial undertakings generally, and to the prosperity of agriculture, and, indeed, of all local interests. A few illustrations will explain this more clearly.

Canada's iron industry—to which I will refer in detail later on—is represented by 18 blast furnaces and several steelmaking plants, located at nine different points in Nova Scotia, Quebec, and Ontario. Of the importance of the hundred and one subsidiary industries dependent on iron and steel, the census returns furnish conclusive evidence. Of these the engineering industry is notable for its growth during the last five years, and for its ability now to undertake large and complicated work. Many new establishments are also under construction in most of the chief centres. I give one example of the latter class, viz., the Canada Car Company at Montreal, with a capital of 3,000,000 dols. The daily capacity of the works will be some 60 wooden and steel freight cars and passenger coaches, besides pressed steel frames for another 60 cars, employing 2,000 men. This concern, the outcome of the building of the new trans-continental railway, has received orders already for 15 cars a day for five years, *i.e.*, 24,000 cars. In textiles, the cotton industry comprises 26 mills, with an aggregate of 500,000 spindles, and 12,000 power looms scattered between Halifax, Nova Scotia, and Hamilton, Ontario, with its chief centres in the province of Quebec. Prior to 1878 only coarse goods could be made, but now the mills excel in many of the finer lines, and they export also a part of their output to China and the Far East. Dependent industries, such as whitewear, shirts, collars, &c., are well-advanced in the principal towns. The woollen industry is represented by 300 mills, in as many centres, making cloths, knitted goods, carpets, &c. These mills are situated principally in Ontario and Nova Scotia. Subsidiary factories of ready-to-wear clothing, mantles, hosiery, &c., employing thousands of hands, are to be found throughout the eastern provinces. Canada's oldest industry—lumbering and saw mills—has grown to enormous proportions, and is followed in every place and corner of the Dominion. The wood-pulp industry with 35 mills, and the papermaking with 40 mills, are well distributed, and every indication points to an industry of the first importance being built up in the immediate future. Furniture, another characteristic industry, with 200 factories, mostly in Ontario, has already established a flourishing export trade; the same can be said of musical instruments, represented by 50 factories, which compete successfully with their German rivals. Boots and shoes are one of Canada's special industries, and rivals its American counterpart in organisation and equipment, and in the cheapness and excellence of its products. Quebec is the stronghold of this trade with 250 factories. Harness and saddlery and leather are again important industries in that province and in Ontario.

The tobacco and cigar industry, with 131 factories, is located in Montreal, Quebec, Toronto, and Hamilton. The canning of fish, fruit, vegetables, and meat, is widespread in Ontario and the maritime Provinces, and its 1,200 factories are generally to be found in the smaller centres; Canada's sugar industry is carried on in four refineries at Halifax and Montreal, and in Vancouver, on the Pacific, the raw material coming chiefly from the British West Indies. The beet sugar industry has also been established of late, with four factories in Ontario, and two in Alberta, North-West Territory. Portland cement making in Ontario and Quebec is rapidly developing, with nine companies turning out 1,500,000 barrels a year; six further concerns are under construction, capable of a like capacity. The local consumption of cement is as high as it is in Germany, and the prospect of an export trade is promising All the works are of the most

up-to-date type, with rotary kilns, and are most favourably located in respect of raw material, cheap power, and water transportation.

Incidentally Canada has built up an export trade in her manufacturing industries of the value of over 20,000,000 dols in 1904. It is true this represents but one-twelfth of the whole export trade, but the character of the articles it comprises is significant, the chief items being agricultural implements, machinery, sewing machines, typewriters, iron and steel manufactures, electrical apparatus, leather, boots and shoes, furniture, pianos, wood pulp and paper, carriages, bicycles, cotton and woollen goods.

The development of manufactures is beyond the capacity of the present local capital, and the supply of skilled labour to grapple with satisfactorily; and the position has become one which offers admirable opportunities for new comers. An earnest of the situation is to be found in the growing imports which in 1904 reached the value of 156,000,000 dols. in dutiable articles, and of 95,000,000 dols. in free goods. Upwards of one half of these imports came from the United States, consisting largely of goods which could be produced in Canada with equal facility.

American Capital in Canadian Industries.

American enterprise has become alive for some time to the manufacturing possibilities of the future in the Dominion. Tentative investments, amounting, it is estimated, to 100,000,000 dols., in industrial production of various kinds, have paved the way for a more comprehensive invasion. It is undoubted that American foresight has proved beyond peradventure the richness of the natural inheritance of Canada, and has done much to awaken in Canadians themselves a belief in its potentialities.

The iron and steel enterprises in Ontario at the Sault Ste. Marie (the "Soo"), and in Nova Scotia, at Sydney, were initiated, and are still largely supported by American capital. The Steel Trust of the United States is known to have made large purchases of mineral lands, and has arranged to put up an immense plant at Port Colborne, Lake Erie, to employ 3,000 hands. Another American enterprise is the Canadian Steel and Coal Company, with a capital of 6,000,000 dols., possessing large properties in iron ore and coal lands. Similar support is also being given to copper, mining, and to developing oil wells, asbestos, mica, and nickel deposits, and to reduction works and other metallurgical processes.

The United States and British Preference.

It is no secret that much of this recent American enterprise in Canada is directly due to the British preference policy. Americans fear this policy, if pressed and developed, will result in the loss to them of much of their trade with the British Empire, and that Canada, with like resources, possesses exceptional opportunities for taking the place of the United States. "Forewarned is forearmed," and so during the last few years a systematic transfer of American manufacturing to Canada has taken place for the double event, *i.e.*, Canada's home and foreign markets. Leading American firms of agricultural machinery have united to put up jointly works employing thousands of hands at Hamilton, Brantford, Stratford, and Toronto for the home and export trade; sewing machine factories in Quebec; locomotive, rolling stock and bridge-building works at Montreal and Toronto; general engineering works for the manufacture of machinery of all kinds—for mining, electrical installation, sugar refining; woollen mills, factories for rubber goods, paint, cereal foods, pork packing; cold storage plants, &c.

In many instances Americans have bought up shares in leading Canadian manufacturing concerns. In regard to timber and wood pulp lands Americans have been specially active in acquiring control of raw material and water powers for those industries in the eastern provinces; American capital also is largely invested in the new Canadian power works at Niagara, Shawinigan, the "Soo," Fort William, and at other points. Indeed, great credit is due to Americans for their shrewdness in turning Canada's prosperity, actual and prospective, to profitable account. "While it matters little to Canadians from a commercial standpoint," says the *Glasgow Herald*, "whether capital comes from America or from Great Britain, there are points of view which make it matter for regret that Englishmen are not taking up these advantages with greater interest."

British Investments.

Apart from investment in Government and municipal securities, railway bonds, &c., the British public at home remain indif-

ferent to Canadian *industrial* investments, preferring risky ventures in South America and equally doubtful quarters when there are such unlimited opportunities in Canada, immeasurably safer, far more profitable, and tending at the same time to build up and strengthen the greatest of the Empire's colonies. It is not denied, of course, that British investment does take place, but, it is feared, too frequently without a proper sense of selection, and in enterprises that are promoted without reference to their success. Speaking on this point a recent *Times* correspondent emphasises the fact that "the American investing in Canada seldom does so as a mere speculation, the results of which he leaves in the hands of others. He comes himself and watches the application of the capital which he or his friends have determined to apply to a given undertaking." In practice, therefore, the American makes safer and much more profitable investments than the Englishman, to whom, of course, the same opportunities are open.

It is not to be inferred that all Canadian and American investments have been fortunate: experience of the two ventures in the iron and steel industry at the "Soo" and at Sydney are cases in point: the causes, however, of their initial lack of success have been entirely due to over capitalisation, lack of technical knowledge, and management.* "There are many directions," says Mr. Jeans,† of the British Iron Trades Association, "both in East Canada and in West, in which capital can be safely invested, but two things are essential to the ultimate success of such investments; first, that the conditions and outlook of the country shall be thoroughly mastered in their several aspects, and, secondly, that the best advice and experience possible should be at the command of the investor." A similar opinion also has been expressed by Sir William White,‡ who visited Canada with the Institute of Civil Engineers last year, to the effect that he and his friends had seen enough to make it certain that in schemes "for the construction of new railways, improvement of waterways, the utilisation of numerous sources of water power for industrial purposes and the execution generally of engineering works, a splendid field was to be found in Canada for the investment of British capital."

* *Canadian Mining Review*, Ottawa, 1903.

† "Canada's Resources and Possibilities." London, 1904.

‡ *The Times*, January 11th, 1905.

INDUSTRIAL OPENINGS FOR SMALL CAPITAL.

Before leaving the subject of British investments in Canada I would like to say a word regarding the man of comparatively small capital—say of a few hundreds to £2,000 or £3,000—with some manufacturing experience, or, at any rate, a good business training, and, above all, judgment and energy. Canada owes much of her present position to the small man. Her leading manufacturers of to-day have risen from small beginnings, and Canada, above all countries, is still the field for such men to-day. This elementary fact cannot be insisted upon too strongly, and for the following reasons. The progress of the country is self-evident and assured; its main source lies in the rapid settlement of the great prairie regions in the West, where wealth is created rapidly, and on a great scale. The demand of the West has already stimulated manufacturing in Canada beyond all precedent, and an ever-increasing volume of orders has to be filled from abroad. An expenditure within the next five or six years of at least £40,000,000 on railways and public works *alone* will benefit and stimulate every interest and every manufacturing centre.

At the present rate of increase it is expected that by 1914 the population of Canada will be not less than ten millions of people. This decade cannot help being a golden age for Canadian manufacturers, small and great. New capital must come from outside, and it will come. Here, then, are the conditions and opportunities for men of the right stamp. Let us take Ontario, the most industrially developed province of the Dominion, and one ideally situated for the small working intelligent investor I have in mind. This is what a leading bank manager had to say last month as to the position of Ontario*:—

"The reports from towns and cities in Ontario with few exceptions indicate a large and prosperous volume in trade and manufacturing, not markedly different from that of the previous year. The maintenance of this high volume has doubtless several explanations, but the prominent reasons seem to be the increasing demand for all classes of goods from the West and the confidence in the immediate future of Canada, in view of the immigration, the extensive railroad building, and the fact that the outside world begins to understand the opportunities we have to offer to energy."

An official enquiry instituted by the Ontario Government as to the industrial openings in

* Annual Meeting of the Canadian Bank of Commerce, Toronto, January, 1905.

the cities, towns, and villages of Ontario in 1903 and 1904 supplies valuable information. The new industries most in demand are canning factories, which are asked for by no less than twenty towns and villages. The same remark applies to hardware industries, while the towns in the north hold out inducements for woodworking establishments, woollen mills, flour mills, evaporators for fruit and vegetables, pork-packing establishments, machine shops, brick and tile yards, and cordage and twine factories, &c. Exemption from taxes, free sites and free water-power are mentioned in many instances as attractions offered by the municipalities to the industries which they desire to secure. Many of the openings are, of course, peculiar to Canada, and of a character which must be examined with caution, but it is evident that where the selection is so wide, the opportunity exists of finding openings suitable to the capacity and circumstances of most people. From my own repeated personal investigations into this matter on the spot, I am more than confirmed in this opinion.

Briefly, then, I would advise those desiring to interest themselves to pay a visit to Canada and carefully look around before committing themselves definitely in any direction: It would be at the very least an inexpensive and invigorating holiday. The best and most disinterested advice is to be obtained by preference with the help of the general managers of the leading Canadian chartered banks in Montreal and Toronto. These gentlemen are thoroughly posted as to existing firms looking for fresh capital for business extensions, as well as in the matter of new industries; and in association with the managers of their local branches they are in a position to usefully advise and safeguard the interests of any capitalist, small or great, who goes out properly accredited. No doubt much useful advice could be had also from the officials of the various local Chambers of Commerce. Investors would thus be able to judge for themselves as to any proposition submitted to them, and have the assurance that they were making the right decision.

What is so true of Ontario is equally true of the other provinces. In the United Kingdom the office of the High Commissioner for Canada is well equipped with information and advice on all such matters and is ready to be helpful. There are also the Canadian Government agencies in the principal centres, Liverpool, Birmingham, Bristol, Cardiff, Manchester, Leeds, Glasgow, Dublin, Belfast, available for the same purpose.

Labour Situation.

The development of manufactures has outstripped the supply of skilled labour in every department, notwithstanding the considerable annual immigration of such labour from outside countries. It has created a scarcity which handicaps manufacturers in keeping pace with their business. Competent workers can be readily absorbed in considerable numbers with the certainty of permanent employment. Unskilled and partially-trained labour is usually procurable locally; wages in all industries have risen; they are about the same prevailing in the United States, but with this advantage that in Canada the cost of living is lower and a higher standard of comfort is enjoyed with opportunities for saving money not realisable here. The classes of workers in request may be inferred generally from the list of prominent industries already given (page 446). The demand is acute for mechanics for agricultural implements and carriage factories, engine and boiler making, and the allied engineering industries, car works, machinists, stove and foundry moulders, men for the boot and shoe and shirt and collar factories, for the furniture and upholstery trades; also female labour for boots and shoes, garments, whitewear, furs, woollens, spinners and weavers. Mr. George Drummond* recently put very pithily the actual and prospective labour needs of Canadian industry, as represented by the number of workers required to produce a reasonable production, 40 per cent., of the present imports of partially and wholly manufactured goods. This proportion is equal to 60,000,000 dols., and on the basis of the last census returns, would call for an army of 42,000 workers to produce. These workers, added Mr. Drummond, with their dependents would in the aggregate form a city of the size, if not of the wealth of Toronto, consuming at least 20,000,000 dols. worth of products annually.

A word is also due to Canadian labour-organisation. The unions hitherto have been on an *international* rather than on a *national basis*, and the 1,500 organisations are largely affiliated with similar bodies in the United States; the latter with a greater preponderance of members and funds, control the psition, and not always, it is believed, especially

* President's Annual Address, Canadian Manufacturers' Convention, Montreal, September, 1904.

of late years, to the best interest of the Canadian workers. There was less objection to this connection as long as Canada was undeveloped industrially; but it is obvious, now that she has outgrown that state, and that the interests of Canadian capital and labour are commercially opposed to and competitive with outside labour and capital, that the time for independent national labour unions is come.

The Ministry of Labour.

With commendable prevision the Canadian Government have felt its responsibility and prepared for these and other labour problems and questions which must attend industrial growth. They have created a Minister of Labour, with a seat in the Cabinet, and have formed a Department which occupies itself with the systematic collection and publication, in an official gazette, of labour statistics and of practical information, special and general, valuable alike to the capitalist and to the worker; it investigates industrial disputes, and promotes their settlement under a Conciliation Act; it secures the payment of fair wages to all employed on public contract work, the influence of which regulations is directed against sweating, and is helping materially to set a standard of wages throughout the Dominion. The Department conducts enquiries into the labour questions arising out of immigration, into existing and new industries and into their social and economic effect. Most practical results have thus been obtained and the work of the Department may be regarded as affording the best guarantee for stability and harmony in Canadian industrial conditions.

Canadian Manufacturers' Association.

Canadian capital is well organised, and on a *national* basis. I must not omit to refer here to the Canadian Manufacturers' Association, which has done so much to bring Canada's potentialities to the front. Five years ago this body was reorganised and has to-day a membership of 1,500, including the most influential and far-sighted captains of industry in the Dominion, who are not only manufacturers of goods, but who "manufacture Canadian enthusiasm, Canadian sentiment, a spirit of independence and a spirit of national pride." The Association is to-day, without a doubt, the most powerful organisation in Canada. The central offices are in Toronto, in close touch with the provincial branches. Standing committees deal with railway and transportation, legislation—federal and local tariff, commercial intelligence and trade expansion, labour and the settlement of disputes, insurance, &c. The greatest efficiency is secured on behalf of the interests represented. An official organ, *Industrial Canada*, is issued and widely circulated free of charge among the Chambers of Commerce in the Empire, the Imperial Consular service, and other similar bodies. For all who wish to keep in close touch with the trend of Canadian enterprise, resources and progress, no better-informed publication can be consulted.

The Coal and Iron Industry.

The determining factor in a nation's position in the world is held to depend ultimately upon the possession of coal and iron. In these essentials to a country's welfare, and its industrial potentialities, Canada is richly supplied. It is doubtful also whether there is any other country richer in gold and silver, in lead, copper, and nickel, and in the other principal metallic and non-metallic minerals, the fuller development of which must shortly command the attention of capital.

The present ascertained coal areas of the Dominion are estimated at 97,200 square miles. The chief deposits at present worked occur on the Atlantic coast in the province of Nova Scotia, the coal here being of an excellent coking variety.

Passing to the provinces of Ontario and Quebec, so far without any ascertained coal measures, and relying chiefly on the United States for mineral fuel, we may observe that this region is endowed with unlimited water-power capable of supplying direct mechanical or electrical energy for industrial purposes. In Western Canada, again, we have coal-beds ranging from lignite in Manitoba to semi-bituminous and anthracite towards the slope of the Rocky Mountains. In British Columbia immense bodies of bituminous coal in the south and east are being worked for the mining industries in the province and in the adjacent United States. On Vancouver Island is found the best coal yet discovered on the whole of the Pacific coast. The mines here are principally worked for export.

The iron ores of the Dominion, says Mr. Jeans, of the British Iron Trades Association, "are unquestionably of great extent and importance but just how much so no one at present can say, because the amount of exploration that has been undertaken is limited." In Nova

Scotia iron ore is found in workable amounts in most of the counties; for all practical purposes, however, the enormous ore reserves of Newfoundland — still politically outside the Dominion—must be included among Canadian sources of supply. The most notable are the hematite deposits on Bell Island estimated to contain 35,000,000 tons, the property of Nova Scotia ironmasters In Quebec extensive deposits of magnetic iron-sand exist on the north shore of the St. Lawrence river, where it is estimated that many millions of tons of ore containing a high percentage of iron, and practically free from phosphorous and sulphur, could be obtained by a good process of concentration. In Ontario the same authority states that "it is doubtful whether in any part of America so great an extent exists of rocks favourable for the occurrence of ore deposits as in Ontario. . . . Already a number of mines have been located both of hematite and of magnetite, and it need not be surprising if within the next five or six years mines are developed in northern and north-western Ontario." Exploration in the last-named district so far has given most satisfactory results, especially in the Lake Superior region. Here, in the Michipicoton district, and in the Antikokan ranges, important bodies of ore are being worked. Indications as tested by the diamond drill go far to establish the fact that the great iron ranges to the south and west of Lake Superior, whence the United States' iron industry derives to-day 70 per cent. of its raw material, extend across into Canada. The Chief Inspector of the Ontario Mining Bureau, speaking of the outlook for the ores of the province, states*—

"Of above 35,000,000 long tons of iron ore produced in the United States in 1902, some 27,500,000 came from the mines of the Lake Superior region, by far the largest quantity that has ever been raised there. Before these tremendous and increasing draughts even the large reserves still remaining will at no distant date disappear, and long before that time arrives the iron ores of Ontario will be in strong demand. All these deposits are tributary to the great lakes, and are carried, by the cheapest transportation known, to the points where they will be required."

Leaving Manitoba and the North-West Territory out of our calculations, we come finally to British Columbia, where ore deposits of high quality are known to exist, and have been located in large bodies within easy reach of ocean transportation. Considerable quantities of these ores are already being exported to the iron industry of the United States on the Pacific Coast in competition with native ores, despite the tariff of 40 cents. (1s. 8d.) a ton to which such importations are subject.

Canada's iron industry of to-day came into existence with the protectionist tariff of 1887. Its growth from that date has been continuous, and to-day there is a capital of 40,000,000 dols. invested in Canadian iron and steel works, and in the iron mines of the country. Successive Canadian administrations, convinced of the necessity of the industry to the national growth, have given additional encouragement in the form of bounties on the production of pig-iron and steel billets. The industry has now reached an advanced point in its formative stage, and may at any time assume the ultimate form of a great industry.

The present equipment of the Dominion consists of four coke and six charcoal smelting plants, with a total capacity of 1,000,000 tons of pig-iron per year, and of five large steel-making plants, capable of producing 500,000 tons of steel annually. The works are at Sydney, New Glasgow, Londonderry in Nova Scotia, Radnor in Quebec, and at Deseronto Hamilton, Midland, Collingwood, and Sault Ste. Marie in Ontario. Certain of these plants have had their vicissitudes, but all are now successfully adjusting their output to local needs. The annual consumption of iron and steel in Canada is estimated to-day at 850,000 tons, with every prospect of a rapid increase. Local production at present is equal to about one-third of the actual capacity of the works referred to, the balance of Canada's total requirements being imported, as to 70 per cent. from the United States, and as to 30 per cent. from the United Kingdom.

The decision of the Government in 1904 to put a protective duty on steel rails—hitherto on the free list—must lead eventually to the production within the Dominion of the greater part of its rail-requirements. These requirements, for the present mileage—20,000 miles —are estimated at 200,000 tons annually,* and with the new extensions in progress and planned, must increase rapidly. The only rail-mill in operation at present is at the Canadian "Soo," with a capacity of 500 tons a day; a second mill of 1,000 tons capacity will be completed in July next at Sydney in Cape Breton on tide water, where the largest

* Report of the Ontario Bureau of Mines, 1903. Toronto.

* "Road-making in Canada," in the *Engineer*, Sept. 30th, 1904.

and most ambitious Canadian iron and steel plant is situated. At this point the conditions of cheap production are admitted to be unequalled on the North American continent, perhaps in the world.* English expert opinion places the minimum average cost of producing pig-iron at Sydney at from 30s. to 35s. a ton:—

	s. d.		s. d.
Iron ores, including mixtures	15 0	to	17 0
Coke	10 0		12 0
Labour	2 0		3 0
Miscellaneous	2 0		3 0
	29 0		35 0
Bounty	12 6		12 6
Net figures	16 6		22 6

Sydney's advantage over Pittsburg, U.S.A., lies in the lower cost of assembling the raw materials for producing a ton of pig-iron. Again, for the export trade Sydney has an advantage over Pittsburg of 460 miles land-carriage to the sea-board, and of about 1,000 miles of ocean-carriage so far as the European market is concerned. These conditions should always prove a great factor in securing for Nova Scotia a pre-eminence in the production of iron and steel. The principal centres of consumption in Canada are in Ontario, and in this province the remaining iron and steel plants of the country are to be found, one of the first magnitude being, as stated, at Sault Ste. Marie. All these plants lie at, or near, lake navigation; they are designed to meet local requirements and the demands that may arise from new industries such as the construction of lake-shipping, which is now of immediate importance in view of the enormous tonnage which Western Canada is providing for transportation in Canadian bottoms to Canadian lake and ocean ports.

The day of the iron industry in British Columbia is not yet. However, the character of the development that lies before that province on the Pacific Ocean, its growing shipping interests, the exceptionally rich local iron and coal deposits, and the distance from the iron industry of Eastern Canada all suggest the probability of early action being taken.

Wood-Pulp Industry.

No country in the world has forest resources equal to those of the Dominion. From the earliest times to the present day the saw-mill interest has stood in the front rank of Canadian industries. Of late years the perfection of the processes for utilising wood in the manufacture of paper has increased many times the value of Canadian spruce forests, and has given Canada another primary industry of such far-reaching importance, in wood pulp and paper, that no apology is necessary for giving the wastes special attention. Sir W. White, in speaking of his recent visit, said*:—"Many opportunities were afforded us to see examples of the utilisation of water-power, and no one can fail to realise the enormous possibilities of development of the pulp and paper industry in Canada with cheap power and a supply of good labour." The province of Quebec has the greater number of the present mills, and together with Nova Scotia and New Brunswick is the natural seat for an industry whose market must lie largely outside the country. Water-power is obtainable almost everywhere; labour is cheap and abundant, and the cutting of pulp wood is easy and continuous throughout the year. An enormous supply of cheap raw material is thus available. Again, by providing settlers on new lands with a cash market for the wood they clear from their land, which was previously unsalable and, therefore, burnt, the pulp industry is a valuable agent in securing the settlement of new districts in Eastern Canada. Upwards of half-a-million cords of this pulp wood last year were carried by the railways across the frontier to paper mills in the United States, all of which might be worked up into pulp and paper in Canada itself were the requisite capital and enterprise forthcoming. Canadian pulp mills are planned for a large output with an eye, both for the home market and for export: some of the mills are devoted exclusively to the export trade, and these, for obvious reasons, are invariably located at or near tide water. The market for pulp is in the United States and England, and on the Continent, in Belgium and in France; the paper goes mainly to the United Kingdom. The tendency of the industry is to manufacture, the whole output of the ground or "mechanical" pulp into the finished article, and additions, therefore, of plant for producing chemical pulp are becoming general. Typical mills of the latter kind are the Laurentide Company, at Grand Mere, near Three Rivers, on the St. Lawrence, making 125 tons of paper and 50 tons of cardboard a day. The whole output is supplied to the United Kingdom.

* "Canada's Resources and Possibilities." London, 1904.

* *The Times*, January 11th, 1905.

The Belgo-Canadian Company, at Shawinigan Falls, in the same region, operated by Belgian capitalists, has an output of about 100 (dry) tons of pulp per day, the whole of which will be shortly turned out in the form of paper, for export. The Chicoutimi mills on the Saguenay river produce pulp only, at the rate of 100,000 tons a year, and this output is to be materially increased. English capital is engaged in this industry on the Miramichi, the St. John, and other rivers in New Brunswick and Nova Scotia. Paper manufacturers recognise that the control of supplies of cheap raw material is essential to the success of their mills in the future, and this fact must ensure the rapid growth of this industry in Canada. As an instance of intelligent anticipation of the future may here be mentioned the recent purchase by a leading London paper company of pulp wood properties and water power on the coast of British Columbia for the supply of their trade in Australia and Eastern Asia. The timber resources of British Columbia per square mile are even greater than those of Eastern Canada. The advantages of cheap power and of open navigation throughout the year will secure in due course for that province a leading position in the pulp and paper trade of the Pacific.

Canadian Water Power.

Probably Canada's greatest industrial asset and the best guarantee of her industrial future lies in her unequalled water-power scattered by the prodigal hand of Nature throughout her vast territory. An idea of the general distribution and of the volume of the power available in Eastern Canada may be gathered from the statement of the distinguised Canadian engineer, *Mr. Thomas C. Keefer, C.M.G., estimating Canada's share of the St. Lawrence basin water-power—between Lake Superior and Montreal—at no less than 10,000,000 horse-power. The value of Canada's water power has been immensely increased, says Mr. Keefer, by the introduction of electro-chemical and metallurgical industries, by the extension and expansion of the wood pulp industry for all of which the country possesses the raw material; and, further, by the success achieved in the transmission of electrical energy over long distances. High pressure currents of 50,000 volts have already been transmitted a distance of 200 miles. Lord Kelvin is reported to place the profitable limit at 300 miles. Thus the future industrial development of Canada will undoubtedly be closely associated with the utilisation of her water falls. It is chiefly, however, in connection with electro-chemical works that Canada may look immediately for the greatest return from water-power, as here it is a question in which intense electricity has a monopoly for the production of aluminium, calcium, carbide, carborundum, and other products, for the generation of which cheap and abundant water-power is indispensable.

* Presidential address, Royal Society of Canada, 1899.

The great future awaiting the electric furnace for the manufacture of iron and steel, phosphorus, &c., must also be borne in mind.

In mining, cheap electrical power is of the greatest value. Canada's great mineral wealth has hardly been touched; her mining districts have abundance of water-power available for electric haulage, pumping operations, air compressors for working drills, ventilation, and other purposes. Again in Eastern Canada new lines of railway and branch lines of existing systems might easily be worked independently by electrical power, thus hastening the settlement of the country and the establishment of industries in districts now difficult of access.

In these and other like directions the control of raw material in conjunction with unlimited electrical power, unrivalled transportation facilities, and a unique geographical position, should enable Canada to play a notable part in the world's industry, with which British capital might be profitably associated.

These possibilities flowing from the use of water-power are not merely in the air, but are now being realised in Canada on a large scale. Within a few months Winnipeg, with a population of 85,000, will obtain all the power required for lighting, heating, traction and manufacturing from a 40,000 horse-power installation on the Winnipeg river 60 miles away. At Port Arthur and Fort William, the Canadian wheat-shipping ports on Lake Superior, the water-power of the Kaministiquia river is being harnessed to supply 80,000 horse-power. At the Canadian "Soo" 60,000 horse-power is already available for local industries including chemical mills, wood pulp mills, reduction works, blast furnaces, and rail mills already established there, and for new industries. At Niagara Falls three Canadian companies are constructing works to develop 375,000 electrical horse-power, and further sites are available at the same spot for an additional 300,000 electrical

horse-power. At Ottawa the Chaudiere Falls, besides driving the largest lumber mills, supply electrical energy for lighting the city, for trams and local railways and various industries of the electro-chemical class. Within a few miles of Ottawa, at the Chats Falls, 200,000 horse-power are available, and within a radius of 45 miles a minimum of one million horse-power. Montreal already uses not only the electric power generated at the Lachine Rapids in the vicinity, and on the Richelieu river, 20 miles distant, but takes over 6,000 electric horse-power from the Shawinigan Falls on the St. Maurice river, 89 miles distant. At the last-named place there are hydraulic works completed for 100,000 electrical horse-power in an ideal industrial position.

Municipal Power Enterprise.

The Ontario Legislature recently conferred wide powers on municipalities to acquire or construct water-power works for lighting and heating and for supplying power for industrial purposes within their respective areas. This will show how greatly the development of local resources and of industries may be assisted in the future by expenditure undertaken by local authorities on power works. Toronto, with a population approaching 300,000, is officially identified with one of the Canadian power companies at Niagara, and expects to derive great advantages from the connection, as the city with all its lighting, railway, and manufacturing demands consumes some 30,000 horse-power annually.

As to relative cost a recent official enquiry establishes the average cost of steam power in Ontario at 35 dols. per horse-power per year, as against 15 dols. per electrical horse-power per year, the latter being the price paid to the Shawinigan Falls Power Company by the Corporation of Montreal. The report says:—

"This company has quite a costly development, and at the price stated pays interest on bonds and dividends on share capital. It may be assumed that municipal power developed under the most competent supervision and charged with a bond interest at a low rate, may be produced at a maximum cost of 15 dols. per electrical horse-power per year. If the consumption, then, of Ontario be tentatively taken at 150,000 horse-power, and the saving at 20 dols. per horse-power, the net *annual* saving to Ontario consumers of electric power developed and sold at cost is practically 3,000,000 dols. This sum capitalised at 4 per cent. represents a capital value of 75,000,000 dols. The actual money value to the consumer would be of course in excess of this owing to the cheapening of production and the stimulus to consumption that would result."

As one of the pioneer plants in Canada in the field of water-power development on a large scale for industrial purposes, the Shawinigan Falls Company call for more than passing notice, and the following particulars have been supplied by the courtesy of the company's secretary, Mr. Howard Murray. The enterprise is due to American brains and capital. The development made is capable of supplying 100,000 electrical horse-power, but extensions much in excess of that figure have been provided for. At present the company furnish over 6,000 horse-power to Montreal, 89 miles distant, and supply also a number of small centres with power for lighting and industrial purposes. At the Falls, a town of more than 4,000 inhabitants has sprung up, and here a number of industries are now established. Among these are the Northern Aluminium Company, owned in Pittsburg, U.S.A., making metallic aluminium by the Hall process. Since October, 1901, these works have produced aluminium continuously, the plant never having stopped its production for a single hour; a plant for making carbons for electrolitic purposes, and one for wire-drawing and cables; here were made the cables for the transmission lines to Montreal. The works use at present 5,000 electrical horse-power, but have arrangements to take up to 10,000 electrical horse-power as required. Another concern manufactures carbide, and has at present a capacity of 5,000 tons; power is supplied in the form of an alternating current of 25,000 volts. Further, a plant for producing ferro-manganese is also in operation, and a linen mill is projected.

The company supplies water direct to factories desiring to install their own water wheels; and of this class is the Belgo-Canadian Pulp and Paper Company, owned by Belgian capitalists and using 8,000 horse-power (mechanical power). As to the industries which would be offered particular facilities at Shawinigan Falls, the secretary writes—

"They would naturally come under the head of pulp and paper mills, electro-chemical industries, requiring large units of power, and in general manufacturing concerns, such as cotton mills, boot and shoe factories, which would obtain in this region, besides cheap power, labour at low rates—a great advantage in such industries. With regard to the cost of power, such figures might be quoted as from 5 to 6 dols. for

water-power (mechanical power) for use in pulp and paper mills, and from 12 to 15 dols. per horse-power for electric current."

The advantage of having at these various points an enormous supply of energy is almost incalculable; and the development of the great water-power companies which have been organised to make those natural resources available, is one of the most profitable and legitimate forms of employment for capital to be found in Canada.

Commission on Electric Smelting.

Impressed by the prospects awaiting the utilisation of electrical energy in the metallurgical industries the Canadian Government sent last summer a Commission to Europe to investigate, test and report on the different electro-thermic processes at present used in the smelting of iron and the making of steel.*

The conclusions arrived at are highly interesting and important, and go to show that in the present stage of development of the electric furnace pig-iron can be produced on a commercial scale at the same cost as in the modern blast furnace when electric energy is cheap and fuel dear, or on the basis taken in the report, of electrical energy at 10 dols. per horse-power per year, and coke at 7 dols. a ton. Under ordinary conditions where blast furnaces are an established industry electrical smelting cannot compete, but in special cases where ample water-power is available and blast furnace coke is not readily to be had, electric smelting may be commercially successful. Structural steel cannot at present be produced economically in the electric furnace in competition with Siemens or Bessemer steel, but such furnaces can be used commercially for the production of high-class steel at a considerably lower cost than by other methods. "Electrical smelting under its present development must be confined for the present chiefly to the manufacture of high-grade steel, and of the many ferro-compounds, such as ferro-manganese, ferro-silicon, &c. . . . . . that a possible field may be the utilisation of iron ores that carry such large amounts of the titanium group of elements as to require a greater heat than is usually permissible or obtainable in a blast furnace, and that the electric furnace may find a greater field of usefulness in this smelting of ore of the more costly metals, such as copper, nickel, &c."

* Report of the Canadian Commission on Electric Smelting, Ottawa, 1904; and *Iron and Coal Trades Review*, December 23, 1904.

Transportation.

Transportation, next to production, is the most important commercial question in a country of vast distances and low-priced products. In no country is inland transportation more economical than in Canada; and it is due to the vast system of inland navigation of the valley of the St. Lawrence and of the basin of the Great Lakes. Cheap water carriage in turn influences the charges for railway transport. In industrial Canada, therefore, we have added to cheap power the cheap assembling of raw materials for manufactures and the cheap distribution of the finished product, a combination of conditions not to be surpassed elsewhere. The tonnage moved annually on the great lakes is not less than 40,000,000 tons, carried chiefly by the United States' lake shipping, whose total tonnage aggregates 5,000,000 tons. During the last three years, however, the number of Canadian lake boats of the large type has greatly increased. At present steamers of 2,000-ton burden can pass freely from the Atlantic by the St. Lawrence river canals to the head of lake navigation—2,500 miles inland. But the bulk of the lake carrying trade is done by freight steamers of 5,000 to 8,000 tons burden, of 18 to 20 feet draught. These enormous vessels cannot go below Buffalo on Lake Erie, owing to the depth of the connecting canal navigation, viz., 14 feet, and the small dimensions of the locks. Further important developments, however, are promised in the near future by the construction of the Montreal-Ottawa and Georgian Bay Canal, affording a 20-foot navigation to the seaboard, entirely through Canadian territory, and permitting the passage of the largest freight steamers. Incidentally it will enable the present lake tonnage to be withdrawn during the winter for employment elsewhere; ocean steamers also of all but the largest size could pass, if desired, to and from lake ports. The trade in grain alone destined for export, *viâ* Atlantic ports, which is carried down the great lakes, is calculated to exceed 5,000,000 tons annually, of which 1,000,000 comes to Montreal. This new canal route to Montreal will offer a saving in distance of 450 miles, and of four days in time over the present longer water route. The saving in freight charges it is stated, will be so considerable—not less than one half the present rates — as to ultimately divert to Montreal the bulk of the export trade in grain and away from its present route *viâ* Buffalo and the Erie Canal and

railways to the American Atlantic seaboard. Moreover, the Georgian Bay Canal scheme would incidentally give Ontario a new front, and with the development of the important water powers occurring all along the line of the canal, create industrial opportunities second to none in Canada. The construction of this canal route is approved both by the Government and by the commercial community; it is now a moot point whether the Government will not itself undertake the building as a public work rather than allow the company holding the charter to carry it out as a private enterprise. In connection with the transportation problem, Mr. Keefer points out the importance of Canada's geographical position in relation to the commercial centre of gravity of the North American continent. This centre is very near Lake Erie. From the western end of this lake (Niagara Falls) the water route to the Atlantic, through the Straits of Belle Isle, follows the general direction of a great circle which cuts the commercial heart of Europe, and is, therefore, upon the shortest route or "air-line." As time goes on the whole of Canada must derive immense advantages from these unique transportation conditions, actual and prospective.

How to Influence Great Britain.

In the light of these potentialities now in course of realisation great things industrially may be expected in Canada during the next ten or fifteen years at most. A conservative estimate of the conditions of to-day would anticipate an even more rapid development in Canada than that which has characterised the United States in the past.

In Great Britain the greatness of Canada's destiny within the Empire finds daily fuller appreciation. The desire for closer communion and for more intimate knowledge has been seen of late years in the official visits of important British institutions and societies to Canada. The British Association has visited Canada twice, viz., Montreal in 1884, and Toronto in 1897, and has been followed by the British Medical Congress. In 1903 the Congress of the British Chambers of Commerce met in Montreal—a most notable meeting; and last year, the Institute of Civil Engineers went over with its President, Sir W. White.

Canada cannot have too many of these visits or see too much of the great captains of industry, and of the men of science from this side, or of English statesmen, such as Professor James Bryce, M.P., and Mr. John Morley, M.P., who have just returned. There are also the too-seldom tried expedients of trade missions, of visits of representatives of groups of industries and of financial interests to study Canada's markets, her fresh sources of raw material, and special undertakings to be developed by British capital and enterprise.

Imperial Commercial Service for Colonies.

In this connection the Imperial Government might be of great assistance. One suggestion I would make is that means be taken to perfect the colonial organisation of the new Commercial Intelligence Office of the Board of Trade, by creating a service of Commercial Agents to reside in the British possessions, these agents to report at frequent intervals through the Colonial Office to the Board of Trade on all matters concerning the resources, growth, local enterprises, public contracts, openings for trade, and the investments for capital, as is now done by H.M. consular officers and the special commercial *attachés* and commercial agents, in regard to foreign countries through the Foreign Office.

Foreign countries undoubtedly derive great and continuous benefit from the issue of these British consular reports and the work of these officials at the expense of the British taxpayer, whereas Canada and the British colonies receive no corresponding assistance whatever in making their claims known. Canada depends solely upon her own service of special agents in this and other countries. The suggested service of Imperial commercial agents to reside in Canada would go far to remedy this seeming neglect, and in any case the defect in the present system of collecting and distributing trade information, to the exclusion of the British colonies. It would materially assist colonial efforts at home and abroad in having their growth and their resources, agricultural and industrial, made known systematically through the Imperial channel.

I would advocate this Imperial commercial service in the Colonies no less in the interests of the trade of the United Kingdom. Manufacturers and merchants at home will remember that their colonial trade, on the *per capita* basis, is relatively more valuable to them than that with foreign countries. It is a trade, therefore, which political considerations and self-interest would see increased, and which should, therefore, have the solicitude

of the Government in providing aids to its development, not inferior to those given to the trade with foreign countries. This the commercial community here has a right to expect. Carefully selected representatives, with a knowledge of the needs and circumstances of the United Kingdom, would be able to select and present information in an acceptable manner, and from the English standpoint. Information supplied from a Canadian point of view, and with a Canadian bias, can never be as acceptable or as authoritative. It is, of course, not suggested that the proposed service should replace, but rather supplement the present commercial agents of the Canadian Government in the United Kingdom, who, while acting mainly in the interests of Canadian export trade to Great Britain, do not hesitate as far as possible to assist the trade of Great Britain with the Dominion.

Congress of British Chambers of Commerce, 1903.

It is also time that the Imperial Government should take some action on the important recommendatons of the British delegates to the Congress of the Chambers of Commerce in 1903, viz., to adapt the British newspaper postal rates to meet those of Canada, which the latter has already put into force with the Mother Country and with the United States—and this, both for commercial, as well as for political reasons; also to co-opererate in arranging greater efficiency in the direct postal service with Canada, and an improved direct British cable service—all suggestions of the greatest possible and immediate importance.

I fear I have wandered somewhat from my theme, but the special circumstances of Canada on the threshold of her new industrial development must be my claim for indulgence in having touched on matters which under other conditions might be considered not altogether relevant to the subject.

DISCUSSION.

Sir Westby Perceval (who took the chair on Lord Ridley leaving to fulfil another engagement) said he was extremely glad of the opportunity of thanking Mr. Just for his able, lucid, and instructive paper. He believed the general impression would be one of astonishment at the magnitude of Canadian manufactures. As had been truly said, every one recognised Canada as a wheat-growing country, and as having vast mineral resources, and great timber tracts, but possibly only a few appreciated sufficiently how very important her manufactures had become, and, what was perhaps more important, the vast field for development possessed by those manufactures. In one respect the paper seemed to afford an illustration of the way in which this country, whether in military warfare or industrial warfare, allowed the other side to get in the first blow. It was significant that the larger proportion of the capital being imported into Canada was not British but American. That was a matter for regret, as was also the fact that a large number of the immigrants into Canada were American or foreign, and not British. It did not matter so much to Canada, but it very much mattered to this country, and possibly to the Empire as a whole. It also occurred to him as somewhat noteworthy—though he did not wish to enlarge on the subject, as it was dangerous ground—that a country like Canada, with such enormous manufacturing capabilities should be the first country to offer Britain a trade preference. It seemed to him to indicate a spirit of self-sacrifice, which, if more widely spread, would certainly tend to remove one of the chief difficulties of bringing about a closer trade within the Empire. At the conclusion of the paper Mr. Just touched on a subject of very great importance, which the paper, when published, would be seen to develop, and he hoped some public notice would be taken of it, namely, that there should be some system for acquainting people of this country officially with commercial information regarding the colonies. Of course, the colonies endeavoured to do that for themselves. They had agents in this country who tried to educate the British public as to the opportunities presented by their respective colonies, but this was not the same thing as an imperial officer collecting and imparting that information, and responsible to the public for its accuracy. That point seemed to be well worthy of close examination, and he hoped that some practical outcome would result.

Mr. S. Charles Phillips said the people of England were always glad to hear of anything which might be for the benefit of the Empire, especially when it came from a gentleman so well informed as Mr. Just. Canada was a country which was going forward all the time, and no doubt she had felt, in years gone by, the lack of British capital. However, he was pleased to see that a better feeling now pervaded the British nation, and that the Englishman was getting to know Canada more as she actually was than as she had seemed to be in our imaginations, helped by the school books of the period. He had visited Canada many times, and was familiar with the country from the Atlantic to the Pacific. Many enterprises were now coming forward which, with the help of British capital, would make Canada shine still more resplendently in the eyes of the British people and the world in general. In the engineering industry, in which he was much interested, it was marvellous how Canada had

forged ahead, and she was beginning to make herself felt even on the other side of the St. Lawrence—*i.e.*, in the United States, of which she was becoming more independent every year. He could bear out all that Mr. Just had said about the magnificent engineering concerns in Eastern Canada, particularly those which had been established by the great Canadian railroads. He believed that in great measure those railroads were becoming quite independent of United States sources of supply. An important industry which had not, on account of the number of subjects to be dealt with, received its due share of attention, was the flour-milling industry, which affected us in this country so vitally, as we were not a self-supporting nation, although we might be "free-fooders" or any other kind of fooders. It was known that Lord Strathcona took a great interest in the matter, more particularly in the mills out West—"Lake of the Woods." It would be a very sorry day for England if the flour-milling industry of Canada were to decline. But there was no danger of that happening; in fact, everything seemed to show that the industry was still paramount, and that it was going to advance with the other large industries of the country. The wood-pulp interest was inseparably wrapped up with the growth of timber in Canada. Canada showed the greatest supply of timber which the civilised world had ever seen, and he believed that country should jealously guard it. English people had for many years felt the benefits of the timber industry from more than half-a-dozen points of view, including timber for furniture, for building, and of late years in providing the wood-pulp used in the composition of the daily newspaper. He was glad to say that millions of dollars were every year being put into the wood-pulp and paper industry of Canada, the chief market of which was this country. Had Canada not been encouraged to come forward and engage in that industry it would have been a bad thing for the British paper trade, as the competition of Norway and Sweden had to be considered in this respect. In fact, Canada had been the means of keeping prices of the raw material from undue inflation—the present prices, which had been forced up abnormally through lack of water supply in Scandinavia being excepted. A high price for paper would have prevented the launching and successful maintenance of the large newspaper ventures which the country had seen.

Mr. T. R. CLOUGHER was glad, from an educational standpoint, that such an admirable paper had been read. There was a vast amount of ignorance in this island about the colonies, and he wished to emphasize the great neceesity of giving Imperial information by Imperial agency. Mr. Just might make statements, and so might he (Mr. Clougher), but they might be regarded by the rather sceptical English public as biased. There might be some present that afternoon who thought the author might have been drawing the long bow; but, from a very long experience, he could endorse what Mr. Just had said. The field for investment was very great in Canada. He, however, differed from Mr. Just in what he said respecting Canada being a good country for the small investor. The proper thing for the small investor was to live in Canada for a couple of years, studying for himself the best point of location and the best advantage which could be offered by the country. He could not afford to gamble; the big investor could, because if he lost in one place he could make it up from another. The man who had two or three thousand pounds to invest must find out for himself where he was investing. People who knew the position he occupied, representing one of the great journals of Canada, were constantly asking his opinion upon such subjects, and he invariably advised them to go to Canada, leaving their money in England until they had learned how to safely invest it. It should not be invested in any concern because the High Commissioner's Department might have said it was good, but because the investor had found for *himself* that it was sound. Why was so little heard about the nickel industry of Canada? Because the chief nickel lands were in the townships of Dennison, Macgregor, and Drury, and held by people in Swansea whose interest it was to keep the knowledge of that interest from this country. The United States had their grip upon other sections, but someday England would wake up to the fact that one of the greatest assets owned by Canada was the undeveloped nickel industry, for nickel was one of the most important component parts of that nickel steel which this country required for its battleships. In the case of metal products, those who were endeavouring to bring about a corner, such as in the copper of the world, had to reckon with Canada before they could say whether the price should go up or down. He joined issue with Mr. Just when the latter said there were no coal deposits in Ontario. It was said at one time that there was no gold in Ontario, and he remembered listening to a discussion in which it was said there was no nickel to be found on the American continent. He hoped that when Mr. Just read his next paper he would be able to say, not only that Ontario had all those beautiful things he had referred to, but that it had coal and iron in the north shores of Lake Ontario.

Mr. J. COLEY-BROMFIELD said he was a recent visitor to Canada, having been commissioned by a syndicate of capitalists to proceed there for the purpose of ascertaining the truth about the capabilities and opportunities for investment. He had in his possession papers which confirmed all that Mr. Just had said. He had read in Toronto papers:—"We do not want artisans and mechanics here; why do they send men from England when our men can do the work?" But that was simply the trade union idea, it being thought that the more Englishmen were brought over the less would be the chance of

Canadians having good wages. His opinion was that nothing could be done in the present day that would at all reduce the earning power of Canada. Canada's opportunities were enormous. There would be no unemployed in this country if the British Government would do its duty to the colonies, and carry out the plan of establishing an Imperial bureau, so as to let it be known where our people could go with the certainty of obtaining employment and receiving good wages.

Mr. CLAYTON BEADLE said he had had the opportunity of visiting Canada recently, more particularly in connection with two great industries which would undoubtedly hold a very important position in the near future—those of cement and paper. With regard to cement, he accompanied the chairman of a very large company in this country to investigate the condition of the industry in the United States and Canada. It was clear to them that Canada was pursuing the same progressive course as was the United States, and putting down the best machinery. The quality of the article, he thought, would compare with that in any part of the world. With regard to the great paper-making industry, the resources of Canada were almost inconceivable, not only as to the available supplies of timber, but also as to the quality of it available for that purpose. It was generally believed that timber, to be suitable for the manufacture of paper, must not exceed a certain diameter. He went to British Columbia and made enquiries about the supplies of balsam, spruce, and hemlock, three timbers which undoubtedly made excellent pulp for paper. Those were very abundant on the Pacific Coast, and timbers from them had been sent to him from British Columbia between six and seven feet in circumference. Most pulp makers laughed at the idea of making pulp from such large timbers. But, by means of the sulphide process, he had succeeded in producing from each of those timbers pulp equal in quality to that imported into this country from elsewhere. It was difficult to account for such large trees yielding such excellent pulp, but he thought it had something to do with the fact that on the British Columbian coast there was a stream from Japan which kept the coast open throughout the whole of the year, so that it was not subject to the same extremes of heat and cold as was the Eastern Coast. He thought it was not generally known that those large trees were available for the sulphide process, and it was only a few months ago that he had the opportunity of investigating the matter.

Mr. JUST, in reply, said unless he found geological data that the rocks of Ontario contained coal he feared he must say coal did not exist there. He had been much interested to hear the comments of Mr. Clayton Beadle on the superior character of the wood-pulp produced in British Columbia by the sulphide process.

On the motion of the CHAIRMAN, a vote of thanks was passed to Mr. Just for his valuable paper.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 15, 1905; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., LL.D., M.D.; Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Carley, Geo. C., 14, Dingwall-road, Croydon.
Cuff, Herbert Mackenzie, E.Ex. A. and C. Telegraph Company, Singapore.
Davies, John Samuel, 9, Clifton-road, Newport, Monmouth.
Dowson, Ernest Alfred, 45, Newhall-street, Birmingham.
Flood, W. H., 1, Northbrook-road, Ilford, Essex.
Parrott, Lieut.-Col. Thomas Samuel, Exploration-buildings, Johannesburg, Transvaal, South Africa.
Prain, Robert P. F., M.Inst.M.M., care of Messrs. Jackson Brothers, Iquique, Chili, South America.
Sabnis, Rao Bahadur Raghunath Vyankaji, Kolhapur, Bombay, India.
Sparks, Hubert Conrad, Suffolk-house, Putney-hill, S.W.
Staver, William H., Casilla 336, Guayaquil, Ecuador, South America.
Thompson, Henry Yates, J.P., F.S.A., 19, Portman-square, W.

The following candidates were ballotted for and duly elected members of the Society.—

Aldwyncle, H. J., P.O. Box 5596, Howard-buildings, Johannesburg, Transvaal, South Africa.
Biliotti, Frank, 8, John-street, Adelphi, W.C.
Bracher, Mrs. L. E., Hamilton, Waikato, New Zealand.
Cooper, William James, A.M.I.Mech.E., A.M.I.E.E., 15A, Turnpike-lane, Hornsey, N.
Crawford, William, J.P., Mount Randal, Belfast, Ireland.
Dawson, David Stewart, 20, Hatton-garden, E.C., and Hotel Cecil, Strand, W.C.
De Landero, Carlos F., Apartado 3, Pachuca, Mexico.
Denny, Harry S., P.O. Box 4181, Johannesburg, Transvaal, South Africa.
Fawcett, Francis Thomas, 135, Nag's Head-road, Ponder's End, Middlesex.
Flannery, Sir J. Fortescue, Bart., M.P., 9, Fenchurch-street, E.C.
Hadaway, William Snelling, Penrhyn-cottage, Bushey, Herts.
Hughes, F. G., Salisbury, Rhodesia, South Africa.
Hutson, Alfred Robert, 123, Darnley-road, Gravesend.
Mitchell, W. F., 26, Craven-hill-gardens, W.
Samuel, S., 11, Portland-place, W.
Smith, W. Ramsay, D.Sc., M.B., Winchester-street, East Adelaide, South Australia.
Sumner, Orlando, Dalry-house, Ashton-on-Ribble, Lancs.

The CHAIRMAN, in introducing the reader of the paper, said he was known to many present as having served with great distinction as bacteriologist and chemical analyst to the Government of the Central Provinces in India; he was particularly selected for the appointment on account of his great distinction at Cambridge in the study of natural science, and in the performance of his highly responsible duties in India he had given the most complete satisfaction. His headquarters were at Agra, where he had all sorts of temptations to study the various artistic beauties of India. He had particularly devoted himself to the subject of the paper, and the discovery which he had to describe was one of very great interest, both practical and theoretical.

The paper read was—

ON SOME DISCOVERIES OF THE METHODS OF DESIGN EMPLOYED IN MOHAMMEDAN ART.

By E. H. HANKIN, M.A.

(Late Fellow of St, John's College, Cambridge, Fellow of Allahabad University.)

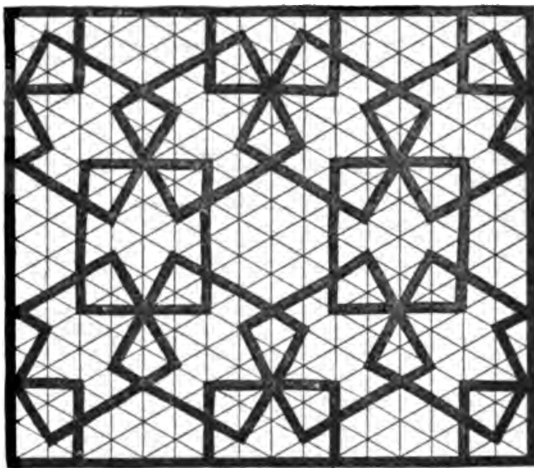
The most striking peculiarity of Mohammedan or Saracenic art is the employment of extremely complicated geometrical patterns. The actual methods by which these patterns were drawn and designed, are, so far as I am aware, unknown to modern artists, either in Europe, in India, or in Egypt. The works of Prisse D'Avesnes, of Bourgoin, or of Gayet, dealing with Arabian art, are equally destitute of any satisfactory explanation of the matter. Some years ago I commenced to study the subject in India. At length, by a lucky chance, I discovered a clue in a small room in one of the palaces of Akbar, the great Mogul Emperor. Here, nearly hidden by dust and dirt, I found the actual construction lines used by the artist some four and a-half centuries ago in producing an arabesque pattern. By means of the clue thus obtained, it became easy to draw the more complicated of the patterns. The clues to the simpler classes of patterns were obtained for the most part by observation and measurement.

The methods that I have to describe to-night, are not simply methods of draughtsmanship. They may be described as methods of design, as by their means it is possible and easy, not only to copy old patterns, but also to design new ones in conformity with the rules of geometrical art.

It may be advisable to explain that the patterns themselves, as I shall exhibit them to you thrown on the screen as black lines on a white ground, are not necessarily or essentially beautiful. They are merely skeletons of beautiful objects. An artist's skill is required to clothe with flesh, the dry bones of geometric design to produce from them artistic creations that impress the feelings and that exist as living triumphs of Saracenic art in the frescoes and tiled dadoes of the Alhambra, in the mosaics, pulpits, and mosques, of Cairo, and in the deserted palaces of Akbar at Futteypur-Sikri.

Geometrical patterns may be divided into the following four classes—(1) square, (2) hexagonal, (3) octagonal, and (4) arabesques.

FIG. 1.



HEXAGONAL PATTERN FROM HAKIM'S BATH AT FUTTEYPUR-SIKRI.

In the first class the space to be decorated is divided into squares. Parts of these squares go to form the pattern. This class will be found described in any elementary text-book of design, and includes various chequers, the fylfots, the Greek frett, rectangular lattices, &c.

The method of drawing the second class of patterns, the hexagonal, is also widely known and calls for no special description. Lines are drawn crossing each other, not at right angles, as in the square patterns, but at angles of sixty degrees, thus dividing the space to be decorated into equilateral triangles. An example of this pattern is given in Fig. 1, which represents a design found carved in plaster in the Doctor's Turkish Bath at Futteypur-Sikri. In this case some only of the pattern lines are identical with the construction lines. Others of the lines of the pattern are drawn crossing

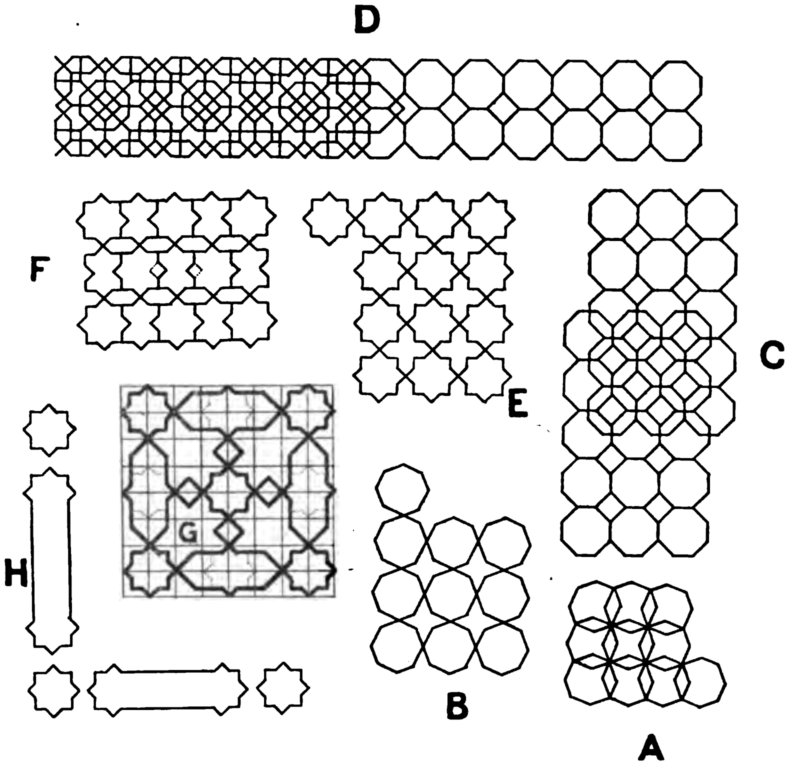
the construction triangles from one apex to another.

The third class of patterns consists of, or is derived from, octagons. Simple examples of this class are shown in Fig 2, at A, B, C, and D. Of these A, B, and C may be found used in stone pavements in the garden of the Taj at Agra. D is frequently employed for the perforated stone balustrades on buildings in the Taj Garden. I have grounds for believing that in drawing octagonal patterns an octagon was

Indeed it is difficult to see how the more complicated of the octagonal patterns could have been designed without the use of templates.

The complicated octagonal patterns usually contain octagons of two sizes, which, so far as my experience goes, may always be regarded as derived one from the other by the following very simple construction. In Fig. 3 an octagon is drawn in which opposite angles are shown joined in pairs by lines such as A B, and C D. The result of drawing these lines is to leave an eight-

FIG. 2.



EXAMPLES OF OCTAGONAL PATTERNS.

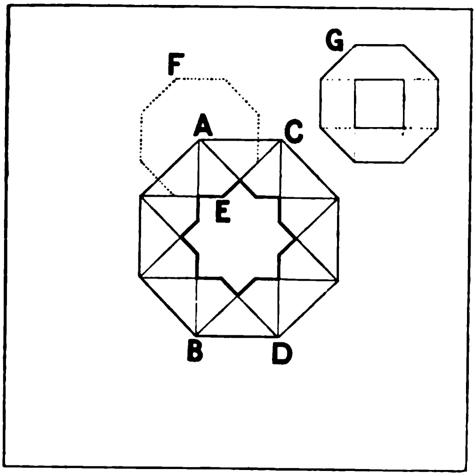
cut out of talc, or paper, or some other suitable material, and used as a template. In the case of Fig. 2, D, the octagons shown on the right of the figure are so accurately drawn (as a rule) as to suggest the use of a template, while the remaining lines are so inaccurately drawn as to suggest that they were filled in by hand. Whether or not a draughtsman should use templates in the actual employment of these patterns may be described as a matter of individual taste and habit. But that templates are useful in the designing of these patterns will be admitted on consideration of the facts contained in the following paragraphs.

pointed star (shown by thicker lines) in the centre of the octagon. Taking the point A as centre describe another octagon (shown by dotted lines) of such a size that one of its angles fits into the angle E of the eight-pointed star. This octagon is shown drawn separately at G. Thus we have a large octagon, a small octagon, and an eight-pointed star. These three figures combined in different ways go to form the majority of octagonal patterns. For drawing the patterns it will be found convenient to cut out these three outlines as templates.

The method of construction of a pattern of this nature is shown in Fig. 4. The large

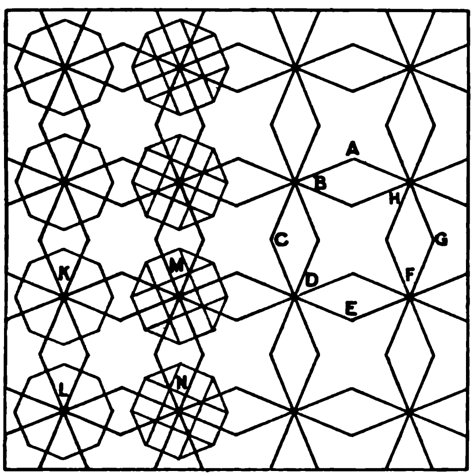
octagon template is first employed to cover the ground with large octagons overlapping by two of their sides, as shown on the right-hand side of the figure. For the sake of clearness the letters A, B, C, D, E, F, G and H, have been inserted to indicate the extent of one of these octagons. The small octagon template must now be used. By its means small octagons

FIG. 3.



DERIVATION OF SMALL OCTAGON FROM LARGE OCTAGON; ALSO OF EIGHT-POINTED STAR. These three figures form the basis of most octagonal patterns.

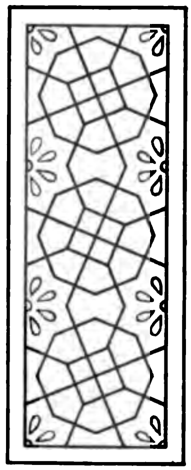
FIG. 4.



CONSTRUCTION OF PATTERN SHOWN IN FIG. 5. The ground is covered with large octagons overlapping by two sides. The letters A to E indicate the outline of one of these octagons. Small octagons, as at K, L, M, N, are drawn round alternate angles of the large octagons.

are drawn whose centres coincide with alternate angles of the large octagon, as shown on the left-hand side of the figure. But this does not produce a graceful pattern. The numerous lines crossing at a point, as occurs at K and at L, like the spokes of a cart-wheel, do not form a pleasing feature. Nor is the case much altered for the better when a square is drawn in the small octagon, as shown at M and N. But when certain of the lines are omitted, as illustrated in Fig. 5, we have a pattern of remarkable gracefulness in spite of its apparent simplicity. This pattern occurs carved in low relief in a panel of red sandstone in Birbul's House, Futteypur-Sikri.

FIG. 5.



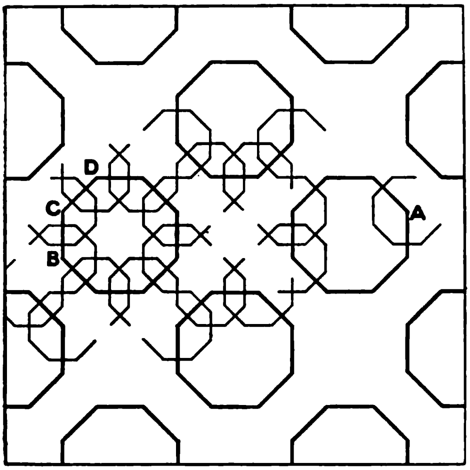
PATTERN FROM A PILASTER IN BIRBUL'S HOUSE, FUTTEYPUR-SIKRI.

It may be asserted that in this pattern the size of the octagon is well proportioned to the size of the panel, and the size of the square to that of the octagon. It is difficult to imagine that this result would have been obtained so successfully had the design been formed without the help of a rational geometrical method.

The construction of another octagonal pattern is shown in Fig. 6. In this case the large octagons are drawn, not in contact, but at some distance from each other. The distance is such that the space between any four adjacent octagons could just be filled by another large octagon. The small octagon template is now brought into use. As shown on the right-hand side of the figure, it is placed with its centre coinciding with the angle of a large octagon. Six sides of the small octagon are drawn in. The operation is repeated round

each of the other angles of the large octagon. Thereby the eight-pointed star is found to have been described in the large octagon. The other large octagons are similarly treated. A few other lines are required to complete the pattern. These are so simply placed as to

FIG. 6.



CONSTRUCTION OF OCTAGONAL PATTERN SHOWN COMPLETE IN FIG. 7. As shown at A, six sides of a small octagon are drawn round the angle of a large octagon. This is repeated round all the other angles (as B, C, D) of the large octagons. The few lines required to complete the pattern may be found by inspection of Fig. 7.

FIG. 7.

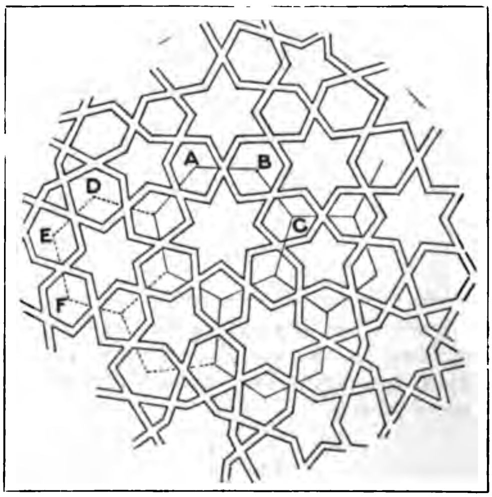
OCTAGONAL PATTERN OCCURRING IN INLAID MARBLE IN THE TOMB OF ITIMAD-UD-DAULA AT AGRA.

require no explanation. The completed design is shown in Fig. 7. It occurs in inlaid marble in the tomb of Itimad Ud Daula at Agra.

The eight-pointed star alone, without the help of any octagons, may also be used to form patterns. Examples of this are shown at E, F, G, and H in Fig. 2. In E eight-pointed stars are placed in contact. This is the pattern of the pavement of the interior of the Taj. F is the basis of a pattern that occurs in a dado in the vestibule of Akbar's tomb at Sekundra. In this case some of the eight-pointed stars are drawn complete. Others are overlapped by their neighbours. Pattern G is obviously formed from eight-pointed stars. A very beautiful example of the use of this pattern will be found in the work of Owen Jones on the Alhambra. H is a common border pattern formed from eight-pointed stars.

We now have to consider the most complicated class of patterns to which the term "arabesque" may be appropriately reserved, as these patterns are practically peculiar to

FIG. 8.



DIAGRAMMATIC SKETCH OF PART OF PATTERN OF A DOME IN THE TURKISK BATH IN THE JODH BAI'S PALACE AT FUTTEYPUR-SIKRI. The lines A, B, C are some of the original construction lines by means of which the pattern was drawn. Examples of the use of this clue are given in the following figures.

Mohammedan art, and both in their complexity and in their æsthetic effect stand on a higher plane than the patterns hitherto considered.

In most square, hexagonal, and octagonal patterns, the pattern lines run in two, three, or four directions respectively. In arabesque patterns the lines run in a much larger number of directions, suggesting that some unusual method was employed in their construction.

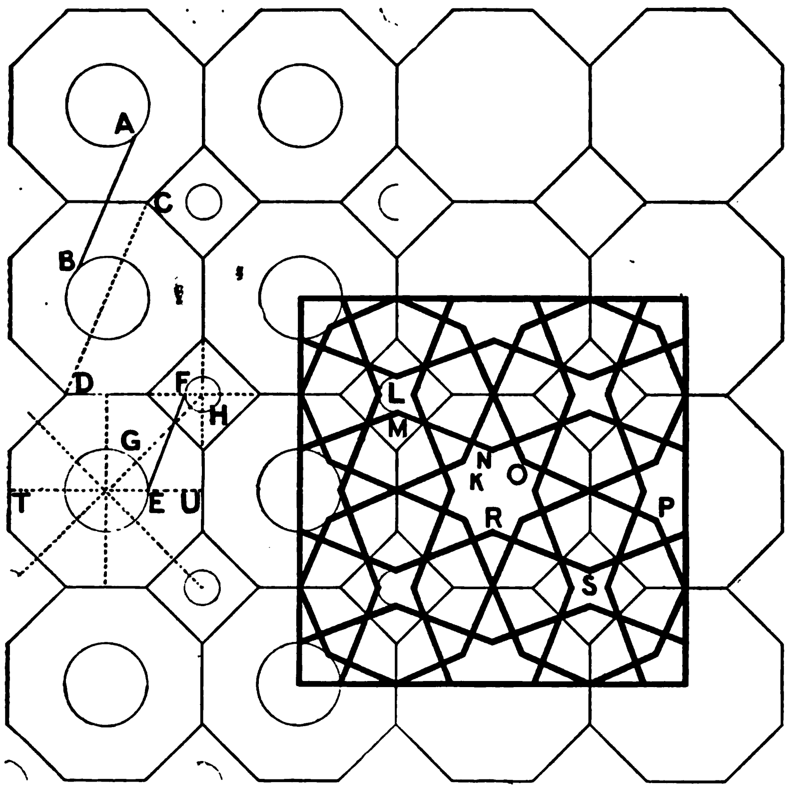
In Fig. 8 is represented diagrammatically part of an arabesque pattern that occurs in a dome in the Turkish bath attached to the Jodh Bai Palace, Futteypur-Sikri. It was this pattern that furnished the clue to the method of construction of arabesque designs. Besides

the thick pattern lines incised in the plaster covering the interior of the dome, I noticed some faint scratches indicated by the lines A B, and B C. On closer examination, I found that these scratches were parts of polygons, that if completed as shown at D, E, F, would surround the five, six, seven, and eight-rayed stars of which the pattern was composed. It at once occurred to me that these polygons were the construction lines used in producing the pattern. It was obvious that polygons in contact were easy to draw. Having drawn them, pairs of lines had to be drawn passing through the centres of each of the sides of the polygons. These pairs of lines crossed the side of the polygon, at nearly the same angle in each case. Each line was prolonged until it met a similar line that had crossed the centre of another side of a polygon. When this had been done all over the surface that had to be decorated, nothing more remained to be done, for the pattern was completed.

A few examples will show how simple is the method here indicated for drawing and designing of arabesque patterns.

In Fig. 9 the space is first covered with octagons in contact, which may be easily drawn by means of an octagon template. The resulting lines may be called the primary construction lines. Two pattern lines have to be drawn through the centres of each of the primary construction lines. The first question is at what angle or in what direction they are to be drawn? Within certain limits the exact angle does not matter provided this angle is the same in all cases. But the best result is obtained if each pattern line is drawn parallel to a diagonal of an octagon. For instance, the pattern line A B is drawn parallel to the diagonal C D. But in practice it will be found easier to draw lines such as T U which pass through the centre of the octagon and join the centres of its opposite sides. A pattern line is then drawn such as E F. This of course is drawn parallel

FIG. 9.

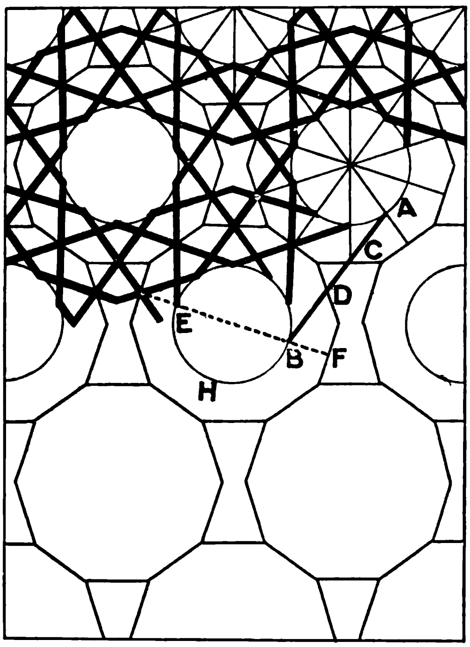


METHOD OF CONSTRUCTION OF A SIMPLE ARABESQUE PATTERN. The ground is first covered with octagons in contact. To form the pattern two lines have to be drawn through each centre of each side of the octagons.

to the neighbouring diagonal of the octagon. It cuts T U in the point E. From the centre of the octagon describe a circle G which passes through the point E. All other pattern lines pass from points similar to E on the circumference of the circle. A guiding circle may similarly be drawn in the squares, as shown at H. These circles and interradii form the secondary construction lines.

In the portion of the pattern shown completed, it may be noticed that the pattern line

FIG. 10.

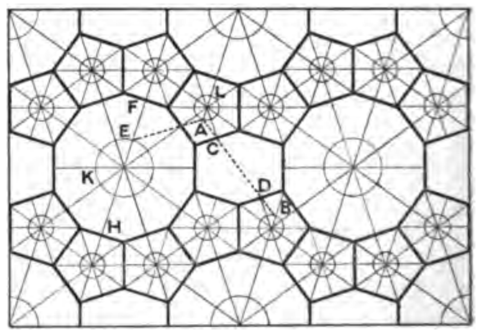


ARABESQUE BASED ON DECAGONS IN CONTACT. Two lines are drawn passing through the centre of each side of the decagon. Each of these lines is continued until it meets another similar line, thus completing the pattern.

M N is nearly but not quite in a straight line with the pattern line O P. This line O P is nearly but not quite parallel to the pattern line R S. A draughtsman not knowing the method now described would probably have drawn M N and O P in a straight line with one another. He would also probably have made O P and R S exactly parallel. So doing would have given the pattern an appearance of stiffness which is avoided by the present method of construction. This pattern is one of the commonest of arabesque designs.

Another arabesque V is shown in Fig. 10. Here the primary construction lines are decagons in contact. As before, two pattern lines have to be drawn through the centres of each of the primary construction lines, and it is necessary to commence by finding out the direction in which these lines have to be drawn. C and D are centres of construction lines. A pattern line A B must be drawn through these two points. This pattern line is continued until it meets an interradius of the decagon at B. From the centre of the decagon a circle H is described that cuts B. Other pattern lines meet this circle at places where it cuts the interradii. This is the most frequent method of finding the position of the secondary construction lines.

FIG. 11.



CONSTRUCTION OF ARABESQUE BASED ON DECAGONS AND PENTAGONS IN CONTACT. The first pattern line is drawn through centres C and D till it meets a radius of the pentagon at A. The second pattern line is drawn from A through the centre of the side of the pentagon, till it meets an interradius of the decagon at E. These two pattern lines give the size of the circles K and L. All remaining pattern lines pass in pairs through centres of sides of a polygon until they reach a circle. The completed pattern is shown in Fig. 12.

In this pattern each decagon of the construction line leads to a ten-pointed star of the pattern surrounded by pentagons. These pentagons are regular if the pattern has been correctly drawn. Other similar arabesques exist in which the primary construction lines are dodecagons and octagons, or dodecagons combined with regular nine-sided polygons. In these cases the resulting star-shaped spaces in the pattern are twelve, eight, and nine pointed, as the case may be, and the pentagons are not completely symmetrical.

We now pass on to consider an arabesque of a slightly higher degree of complexity. In Fig. 11 its primary construction lines are drawn as thick lines, and its secondary con-

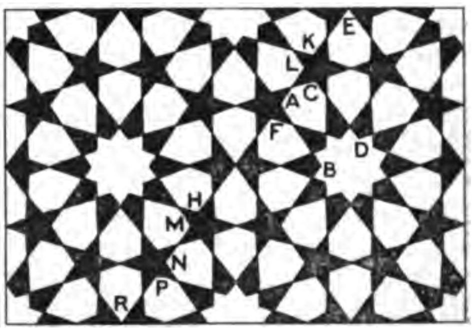
struction lines are drawn thin. The primary construction lines consist of regular decagons, regular pentagons, and irregular hexagons. The templates for this pattern consist of a decagon and a pentagon. Or more conveniently a decagon may be drawn with a pentagon attached to each of eight of its sides. This may be cut out of paper as one template. Such points as are required that are not on its periphery may be pricked through on to the drawing paper by means of a fine needle. The irregular hexagon requires no template. It is merely the space left where there is no room for pentagons.

In this pattern the secondary construction lines are found by the following easy method. The first pattern line A B is drawn through the centres of two construction lines at C and D. It is continued till it meets radii of the pentagons at each end, as at A and B. A circle L is described in the pentagon cutting the point A. A second pattern line A E is now drawn. This starts from the point A and passes through the centre of the side of the pentagon. It is continued until it meets the interradius F H of the decagon in the point E. A circle K is now drawn in the decagon that cuts E. All the pattern lines have to be drawn starting from analogous points on the circles K and L, or from similar circles drawn in the other polygons.

The completed pattern is shown in Fig 12. For the sake of making the pattern easier to comprehend, alternate spaces are tinted, as might be the case if it was used in a mosaic pavement. It is well to notice that, as here drawn, the lines E K, L A, F H, M N, and P R, are not quite in a straight line with one another. An artist not knowing the correct method of drawing the pattern would, with little doubt, have made of these lines a hard straight line running through the design, like a line in the pattern of a cane-bottomed chair. He would have added to this resulting and unnecessary stiffness, by making the rays of the ten-pointed star of parallel lines, which is equally a mistake, for A B and C D are nearly but not quite parallel.

A still more complicated pattern is shown in Fig. 13. Though the effect of the pattern, as here drawn, is surprising rather than pleasing, in the original, as it exists in a dado of coloured tiles in the Alhambra, it is a very beautiful object. An illustration of it may be found in the work of Owen Jones on the Alhambra. My drawing only represents a quarter of the panel, the point A being the centre. The method of construction though tedious is by no means difficult. Round the centre A describe a dodecagon, of which one quarter is shown at E F H. Touching this dodecagon at the point F, another dodecagon of the same size has to be drawn. It is lettered F K L Y and shown drawn round the centre N. Touching the dodecagon round N at the point Y is drawn a third similar dodecagon, whose centre is at O. Touching this latter at Z is drawn a fourth dodecagon whose centre is at R. Inside each of these large dodecagons are to be drawn smaller dodecagons. Their size is found as follows:—Join E K. On a radius of dodecagon A mark off E B equal to E K.

FIG. 12.



ARABESQUE BASED ON DECAGONS AND PENTAGONS IN CONTACT. Notice the lines A B and C D, and similarly placed pairs of lines, are not quite parallel. If they had been drawn parallel, the pattern would have been more stiff and less yleasing. The lines E K, L A, F H, M N, P R, are nearly, but not quite, in the same straight line with one another. This also prevents stiffness, and supplies an additional proof ot the advantage of the method ot construction explained in this paper.

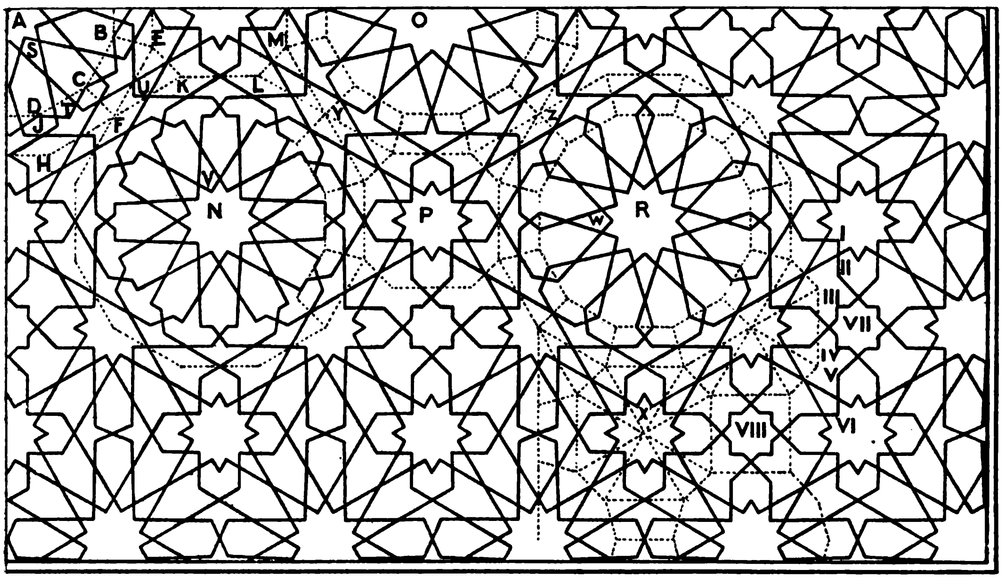
Then A B is the radius of the small dodecagon required. This is shown drawn and lettered B C D in dodecagon A. A similar small dodecagon has to be drawn in each of the other large dodecagons. A remaining feature of the primary construction lines is seen as an irregular octagon at P. This is merely the space left between the four large dodecagons A, N, O, and the fellow of N, which would have been drawn had the adjoining quarter of the panel been represented. Half of this irregular octagon is shown at E K L M. This space is repeated at P, and elsewhere in the pattern. The radii of this octagon must be drawn in as shown at X. No further description is needed of the primary construction lines.

The secondary construction lines are very simple. As may be seen by inspection, a number of the pattern lines are drawn, simply passing through the centres of two or more construction lines without any further guidance being required. In dodecagon O is drawn a twelve-pointed start of normal type. The twelve-pointed stars drawn round A, N and R are modified to give further variety to the pattern. It may be well to state that in solving the method of construction of this pattern, I had at my disposal only a very rough tracing of the not altogether accurate drawing in the work of Owen Jones. Consequently I had to rely to some extent on my general knowledge pointed star similar to those present in other parts of the design.

At VII and VIII (in Fig. 13) an eight-pointed star is shown. The primary construction outline for this star is a square, shown round VIII. The exact size of the eight-pointed star is a matter of taste. I have drawn it in such a way that the pattern lines I, II, III-IV, V-VI, are all in a straight line with one another. The original drawing is not sufficiently accurate to determine this point.

In Fig. 14 is represented a panel from the side of a stone pulpit in Cairo, copied (with some modification) from Stanley Lane Pool's work on Saracenic art.

FIG. 13.



METHOD OF CONSTRUCTION OF AN ARABESQUE BASED ON DODECAGONS, FOUR-SIDED FIGURES AND TRIANGLES. From a tiled dado in the Alhambra. One quarter only of the repeat is shown.

of the subject. The twelve-pointed star drawn round A has been made of such a size that the spaces S and T are equal to each other, and also equal to the space U. The space J is made as far as possible symmetrical. The twelve-pointed star drawn round N is made of such a size, that the space V is equal to U. A similar consideration governed the size of the space N in the star drawn round R. The irregular octagon P is adapted to produce an irregular eight-pointed star. This would be a blemish in the pattern. Consequently alternate points have been thrown back, as shown at X, which has been done in such a way as to produce a symmetrical twelve-

For drawing this pattern two templates are required. One is a regular sixteen-sided polygon. The other is a regular heptagon, the length of whose side is the same as the length of the side of the sixteen-sided polygon. Perhaps for convenience of description I may be allowed to refer to the latter as the "16-gon."

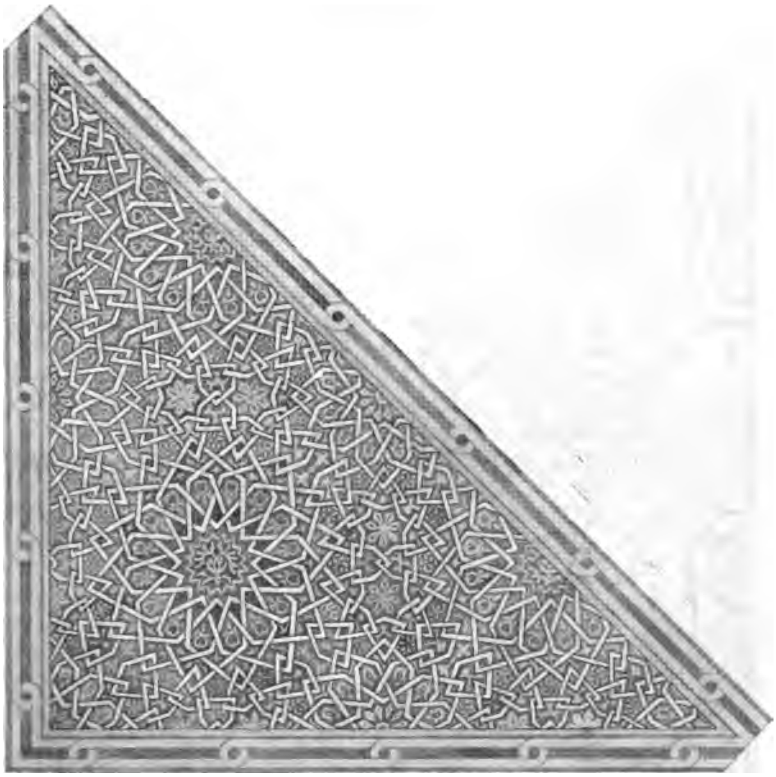
With the 16-gon template draw the outline B shown in Fig. 15. Place the heptagon template with one side touching B at K H. By this means draw in the heptagon D E F G H K L. Two sides of this heptagon, F G and G H, are indicated merely as dotted lines as they are not further required. The centre of this heptagon is at N. A second similarly situated

heptagon is now drawn in having its centre at P. The 16-gon template is now placed touching the sides E F O of the twinned heptagons, and a 16-gon is thereby drawn shown at A. Twinned heptagons are similarly drawn at symmetrical intervals round the original 16-gon B, and on one side the twinned heptagons indicate the position of another 16-gon which is shown in the figure drawn round C.

one of its sides touches, or is the same as, the side of its fellow.

The primary construction lines have now been completed. The secondary construction lines consist of the radii of the different polygons, and of one or two circles drawn in each of the polygons. Within limits the exact sizes of these circles do not matter. By trial and error a suitable size can easily be found.

FIG. 14.



PATTERN FROM PANEL OF A FOURTEENTH CENTURY STONE PULPIT IN CAIRO.
(Modified from Stanley Lane Poole.)

Between the 16-gons A, B, and C, is left a space which is filled up by a dodecagon R. Similar spaces are filled up by similar dodecagons at S and I, and also (partly drawn) at the three corners of the panel. These dodecagons are not quite symmetrical, but must be drawn as regular as the space available permits.

In each of the twinned heptagons smaller heptagons have now to be drawn, such as those shown with centres at N and P. Each of these heptagons has its centre identical with the centre of its larger surrounding heptagon, and is drawn of such a size that

In the previously described arabesques, the pattern lines were drawn through the centres of the construction lines. In the arabesque now under consideration this is not the case. Each primary construction line, that is to say, each side of a polygon, is to be divided by two dots into three equal parts. The pattern lines are drawn through the dots. Some of the pattern lines have been drawn in as dotted lines in part of the figure. These will serve as a guide to enable the student to complete the pattern with facility.

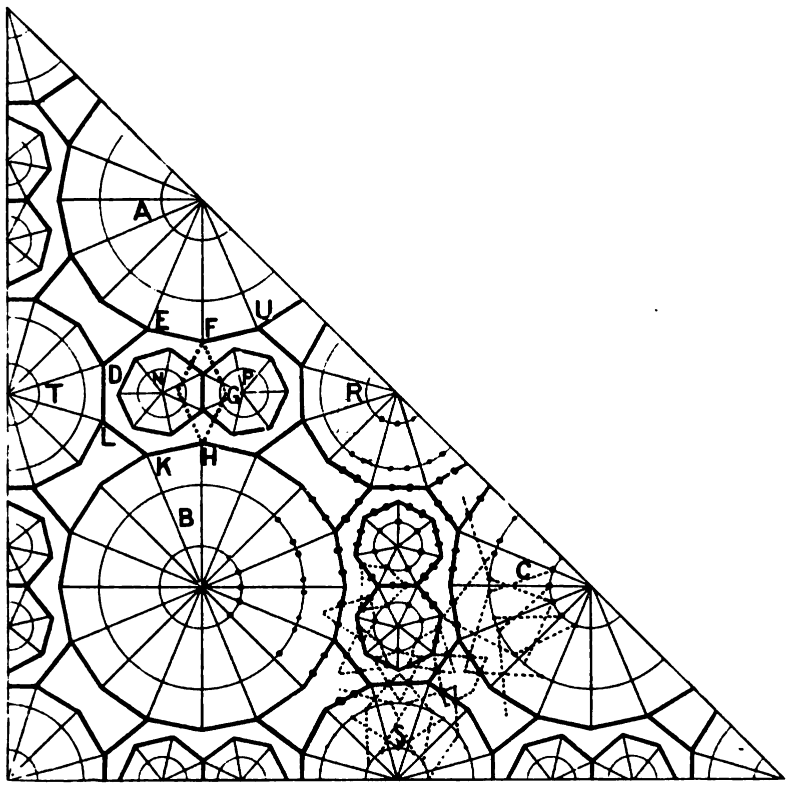
Supposing it is required to discover the construction lines of any given arabesque, proceed

as follows. Mark the centres of all the larger spaces included in the pattern, excepting, as a rule, the star-shaped spaces. Join these centres. The polygons thus produced are the primary construction lines. Supposing it is required to copy an arabesque that exists on a ceiling, or in some other inaccessible position, a similar method will suffice. On looking at the pattern, it is easy to imagine lines joining the centres of the larger spaces, which lines describe polygons. A rough sketch may be made of these imagined polygons. From this, at leisure, an accurate drawing may be made. In doing so it is necessary to make the different polygons as symmetrical as possible, and, so far as possible, having their sides all of equal length. Guided by this rule, and after a little practice, any complicated arabesque pattern can usually be solved in ten minutes. On the other hand, I personally have failed to solve some of the apparently more simple patterns despite a more extended study.

It will be advisable to conclude with a few remarks on some of the rules observed in Mohammedan decorative art.

One of the objects of decoration is to prevent the eye being displeased by monotony. A geometrical pattern, however elaborate, if used too much, will produce that effect of monotony that it was intended to prevent. It will then become as tedious to the eye as a Greek fret was to Ruskin, or as a cheap floral wallpaper may be to anyone else. In some of the best buildings in Futteypur-Sikri, the artist has nearly worked up to the standard of discarding each pattern as soon as he had used it once. In Birbul's house, for instance, a number of richly-decorated pilasters are present in the different rooms. Each pilaster has, on its face fronting the room, three carved panels. On each pilaster the upper and lower of the three panels bear the same pattern, but the middle panel always carries a different pattern, and the patterns used on one pilaster, so far as I

FIG. 15.



METHOD OF CONSTRUCTION OF PATTERN SHOWN IN FIG. 14. As shown in lower part of the drawing, each side of a polygon is divided into three equal parts by two dots. The pattern lines are drawn through these dots.

am aware, do not occur on any other. These patterns are nearly all geometrical, but a few are floral, thus further preventing any impression of monotony. One of these pilaster patterns is shown in Fig. 5.

That the pattern should be adapted to the space it has to occupy is a truism observed in almost every system of art. In the case of geometrical patterns, this truism admits of a simple geometrical expression, which, with rare exceptions, is adhered to by Mohammedan artists, and ignored by European artists when copying Mohammedan designs. In all the patterns used to illustrate this paper, star-shaped spaces occur at regular intervals. The rule very generally observed in Mohammedan art in India is that each corner of the panel is occupied by a quarter of one of these star-shaped spaces. If several repeats of the pattern occur in the panel, half stars will occur along the sides, besides quarter stars in the corners. The panel always contains a whole number of repeats. If the pattern contains eight-pointed stars, the space included in the stars may be filled up by fylfots (or outlines of that nature), and then adherence to the rule is only to be discerned on studying the construction of the pattern. In some of the perforated stone balustrades that form so pleasing a feature of the buildings in the garden of the Taj at Agra, the pattern has been visibly and greatly distorted to ensure compliance with this rule in the space available. The tomb of Itimyad Ud Daula in Agra offers a striking illustration of the observance of this convention. Worked into its marble mosaic are hexagonal, octagonal, decagonal, and dodecagonal patterns, in the greatest profusion, but in every panel, whatever its size and shape, quarter stars are always to be found in each of its four corners. The difficulty of designing the building must have been greatly added to by the observance of this rule. One is tempted to suspect that the building was designed to fit the patterns.

In Mohammedan art as it occurs in Egypt and Spain this method of adaptation to the space is sometimes followed. At other times a different plan is adopted, an example of which may be found in Fig. 13. As already explained, this drawing represents only a quarter of the complete panel. The border is therefore only shown on two sides, indicated by double lines. Had the pattern been used by a Mohammedan in India, the corner would have been occupied exactly by a quarter of a star, and half stars would have occurred along the sides. But the Moorish artist has put more than a quarter of a star in the corner, and more than half stars along the sides. The arrangement is such that the rays of the stars along the sides form a sort of inner border which is accentuated by the colouring adopted in the original design.

Owing to observance of this rule a panel of given shape is not suitable for the reception of any and every pattern. If the panel is a square, or if it is made up of a whole number of squares, it may be decorated by an octagonal pattern, or by those octagonal and dodecagonal arabesques whose repeat is a square. The repeat of a hexagonal pattern is usually a rectangle whose diagonal forms an angle of 60° with the base. Such patterns are, therefore, not applicable to square panels, but only to panels that are rectangles of this proportion, or to panels that may be regarded as made up of such rectangles. The repeat of arabesques whose primary construction lines include decagons is usually a rectangle, whose diagonal forms an angle of 36°. In "Les Elements de L'Art Arabe," by Bourgoine, may be found a large collection of arabesque patterns. In some of these patterns that contain 14-rayed stars, the unit of pattern is a rectangle whose diagonal forms an angle of about 38°. With sufficient knowledge a pattern may be found to suit a rectangle of almost any shape.

A few words may be added as to the amount of accuracy needed and advisable in drawing geometrical patterns. In elementary textbooks of design it is commonly asserted that pattern outlines look better when drawn in by hand than when drawn in by compass and rule. The truth of this statement may be admitted without reserve so far as the simplest pattern shapes and outlines are concerned. With regard to less simple patterns, however, some reservation is necessary. If a hexagonal pattern is made with the aid of construction lines that have not been drawn at exactly the correct angle, every hexagon in the pattern will be distorted. If lopsidedness occurred in a single hexagon it perhaps would not matter. But when every hexagon is lopsided to the same extent, and in the same direction, the effect is cumulative and unpleasant. The suggestion that the artist was trying to draw hexagons and failed because he didn't know how to do so, is a suggestion that obviously should be avoided. If, however, the construction lines of a hexagonal pattern are drawn in

with accuracy, the pattern may well be drawn in by hand.

Arabesques are usually found drawn accurately. In the case of the more complicated arabesques, this would seem to be necessary to produce their full æsthetic effect. But a relatively simple arabesque, such as that shown in Fig. 12, may be distorted in order to make it fit the space; that is to say, to get exactly quarter stars in each of the corners of the panel. In order to do this it is necessary to draw first the construction lines, modified or adapted to the space, and then on these lines to draw the pattern.

By observing which patterns were placed in prominent positions and which were placed where they could not attract much notice, it is possible to arrive at some ideas as to what features of a pattern were considered good by Mohammedan artists. A pattern containing several lines crossing at one point like the spokes of a wheel, as already mentioned, is not much used. The best patterns are those in which all the constituent spaces have either a radial or a bilateral symmetry, that is to say, are free from lopsidedness. A pattern is bad if it contains spaces of the same shape but differing slightly in size. If a construction leads to such a result, the pattern must be modified so that the spaces become either identical in size or else widely different. Cases have been mentioned in this paper in which gracefulness in a pattern is obtained by drawing it in conformity with some geometrical rule. Cases also may be found, though rarely, in which the geometrical method leads to a clumsy result, that can be remedied by freehand drawing.

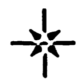
DISCUSSION.

The CHAIRMAN, in opening the discussion, said, Mr. Hankin's claim on their attention was that he had discovered at Futehpur Sikri, the Windsor of Akbar and his son Jehanghier, in the bath-room attached to the *Jodhbai Palace, the actual draughts of some of the geometrical projections on which "the Saracens" are believed by many, and Mr. Hankin shares their belief, to have planned the characteristic patterns, or at least the more elaborated of the patterns, known as "arabesques," used by them in the decoration of plane surfaces with sculpture, mouldings, and paint, and mosaics, encaustic tiles, and inlays of mother of pearl, ivory, ebony and metals, and, in the case of carpets, hangings, and other textile fabrics ["Turkish tapestry"], with broidery in "blue and purple and scarlet." This is the narrowly limited technical question Mr. Hankin's discovery revives, and yet it is impossible to discuss it, even within its most closely restricted technological scope, with any adequate intelligence, independently of its relation to the wider question of the origins of the inspiration and constructive features and mechanical methods of "Saracenic" art—so-called. The earliest building in Arabia that can be unhesitatingly attributed to the Shemitic Arabs, as distinguished from the Hamitic Adites, is the *kaaba*, or "Cube-house" at Mecca, and as rebuilt in the days of Mahomet himself, it was the work of a Greek, called Bakum by the Arab writers, and a Copt. They were in charge of a large cargo of "Greek glass" for the decoration of a Christian church in Abyssinia, and having been shipwrecked near Jidda, were impressed by the Khoreish Arabs for the restoration of the *kaaba*. The Caliph Omar, the successor of Mahomet, built the "Sacred Mosque" (*masjid'l-haram*) round, or rather foursquare, about the *kaaba*, and Burkhardt was quick to notice that the only good decoration on it was of Greek design and workmanship, and that all that was, as might be presumed, of native handicraft, was most coarsely and ignorantly executed, some of the pillars of the colonnade being set up in their places upside down. Second in sanctity to the Mosque at Mecca is the "Mosque of the Prophet" (*masjid'un-nabi*) at Medina. As built by "the Prophet of God" himself, it was a plain building of sundried bricks, unhewn stone, and date palm stems and branches. It was extended by the Caliph Othman, the successor of Omar; he using hewn stone and Indian teak wood on the work. At the beginning of the eighth century it was entirely reconstructed by the Caliph Walid I., the 7th Ommiad Caliph, and 12th from Mahomet, who, ambitious to make it the most splendid public building in the world, asked the contemporary Roman Emperor at Constantinople to supply him with Greek workmen for the purpose; and the Emperor sent him 40 Greek and 40 Coptic workmen, with 40 loads of "Greek glass," beside silver lamp chains, and other finely "arted" appliances, for the more decorous furnishing of the Mosque. This same Walid had previously, when about to build the famous *jami'-masjid* at Damascus, and the so-called "Mosque of Omar" at Jerusalem [the *kubatu's-sakhrah*, or "Dome of the Rock" of the Muslims, because occupying the site of King Solomon's Temple], entered into a regular contract with the Roman Emperor at Constantinople to supply him, according to his need, with *fsefysa* [also written *fuseyfisa*, and *fesfesa*], this Arabic word for "Greek glass," being none other than the Greek word *psephos* "a pebble." The "Mosque of the Prophet" at Medina was

* Jodhbai, was the Rajput Princess of the House of Jodhpur, who married the Emperor Akbar, and became the mother of his son Prince Selim, better known by his imperial name of Jehanghier. The Jodhbai Palace was sacrilegiously and outrageously blown up by us as an experiment in military mining in 1840.

the first Muslim building that in construction or decoration varied from the pre-existing Christian buildings in Syria and Egypt, and signalised the dawn of a new order of architecture. But Egypt was the centre whence the perfected "Saracenic" art, so-called, radiated Westward over "tawny Spain," and Eastward beyond "the farthest steep of India." Of the "Mosque of Omar" at Cairo, founded in the middle of the seventh century, and rebuilt at the beginning of the eighth, the record is that the pulpit therein was taken from one of the churches at Fustat, the old suburb of Cairo that gave its denomination to "fustian," and set up in the mosque by the Copts engaged in its construction. The "Mosque of Ibn Tulun" was built late in the ninth century, under the direction of a Copt named Buktur. It presents the foremost examples to be found in Egypt of the use in Muslim buildings of the scrolled and geometrical decorations, specifically termed "arabesques." The oldest example of "Saracenic" architecture in Spain was the mosque, now the Cathedral, but still called the "Mesquita," at Cordova, built by Greeks expressly brought from Constantinople, late in the eighth century, by the Caliph Abdurrhaman; who, like Walid I. in the case of the "Mosque of the Prophet" at Medina, was determined to make the Mosque of Cordova the wonder of the world. The distinctive "Saracenic" style of Spain reached its highest splendour, during the thirteenth and fourteenth centuries, in the enchanting elegance, and brilliant luxuriousness of the Alhambra [*kalat al hamara*, "Castle Red"] at Granada, and when the Turks in the fifteen century, on taking Constantinople, converted the Church of St. Sophia into a mosque, and made it "the glass of fashion, and the mould of form" to be observed of architects throughout Islam, and would thus have renewed the direct influence of Byzantine art on "Saracenic" art, the Mosques of Cairo and Cordova, still served to sustain something of the dignified severity of form, and the stately simplicity of ornamentation of Egyptian and earlier Spanish "Saracenic" art under the degrading influences of the now ubiquitous domination of "the Turks and Tartars" of Constantinople. The extension of the sphere of Islam under the Turks led to the gradual provision of an immense body of Muslim craftsmen, including Aryan Persians and Aryan Hindus, and the variety of Saracenic art known as Moresque was developed under the employment of Muslim *mistris* on buildings for the use of Christians as, for example, at Toledo. The influence of Byzantine Greek art [which itself grew out of Græco-Roman and Perso-Buddhistic art] on "Saracenic" art is to be traced not only in the austerity and reticence of its classical examples in Egypt and Spain, but in the scornful and defiant obtrusion by the "merry Griggs" in the "arabesques" they designed, of living forms, even animal forms, the representation of which is strictly forbidden to Muslims. One of the Greeks sent to build the Mosque at Medina actually sculptured a hog on the *kiblah* wall of the mosque. Mocking animal forms peer out in every direction from the fantastic "arabesques" of the Alhambra. The use of the Christian cross in the domestic architecture of the Muslims of Egypt, a practice continued to this day as a defence against evil spirits, is a most pertinent indication of the manner in which "Saracenic" art at its birth was controlled and directed by the Copts. Then:—the horizontal stripes of buff and red, so marked a feature of the street architecture of Alexandria and Cairo, are to be traced to the Roman mode of strengthening buildings of brick with courses of stone:—the arch, the "Saracens" took from the Romans, and the Byzantine Greeks, and, it might be, from the ancient Assyrians, but the typical horse shoe arch of "Saracenic" art was suggested directly by the iconic niche of the Buddhists, the curves of which were determined by the head and shoulders of the image standing, or sitting, within it:—and the simpler, or purely geometrical forms of "arabesque" work grew out of the necessity of using wood when employed in tropical and semi-tropical countries for the ornamental covering of plane surfaces, in the form of pannels, in order to counteract the effects of warping. The dome is directly of Byzantine derivation, and indirectly Assyrian. The lightness of the "Saracenic" buildings may possibly be derived from the tents of the Arabs, and the inspiration of the airy date palm, while the extended width and flatness of the walls, and the decoration of them with "arabesques," is certainly due to the practice followed in all Oriental countries on occasions of domestic rejoicing, and popular fairs and festivals, of erecting vast latticed booths and smothering them all over with palm branches and long twines of creepers and garlands and festoons of all kinds of flowers, after the manner of the *gloirettes* to be seen in southern France, and sitting eating and drinking and making merry in them for days together. The minaret he would identify with the cypress, or the cypriform tamarisk of Persia, "the Shaft of Isfendiyar." The rapid diffusion of "Saracenic" art over the whole area of Islam was greatly promoted by the immemorial Oriental customs of artizans travelling about from country to country and offering their services to the rich and the mighty, and of great conquerors carrying away the artistic treasures of the countries they subjugated, and making captives of the artizans of the vanquished for the adornment of their own palaces. In this way, Nebuchadnezzar (2 Kings xxiv. 14-16, and Jeremiah xxiv. 1) carried off "the carpenters and the smiths," "and all the craftsmen" that were in Jerusalem to Babylon; and Xerxes robbed some of the cities of the Greeks of their most sacred statues (Strabo xi. 11, 4—xiv. 1, 5; Pausanias i. 8, and 16—iii. 16—viii. 46, &c.; and Arrian xix.); and that the Sultan Selim I., when he annexed Egypt to the Ottoman Empire in 1516, deported the whole of the higher class of craftsmen of the country to Constantinople, leaving behind only a

few of the lower craftsmen, engaged in household and domestic arts, such as the embroiderers of "arabesques" on caps and robes and shawls,—who to this day are for the most part Greeks. This was the death blow to the exemplary tradition of "Saracenic" art in Egypt. It is by such natural processes that in every age the arts of human life have arisen into being, reached their zenith, and then declined, and often perished altogether. When the Greeks were reduced to "devil" for the Aryan conquerors of the Western Roman Empire, and the Shemitic conquerors of the Eastern Roman Empire, they created on the one hand Gothic art, and on the other "Saracenic" art, and just as Gothic art took its varying phases in Germany, Italy, Spain, France, and England, "Saracenic" art assumed its several local types in Egypt, Spain, India, and Central Asia. So long as it was fashioned by actual Aryan hands it was preserved in the pristine purity of the style of Cairo and Cordova, but when it came to be manipulated by the Turanian and the Negro races it degenerated into vulgarity and inanity. It was indeed the unreserved absorption, on absolutely equal terms, of the Black and the Yellow races within the pale of Islam that led to the decadence of Saracenic civilisation in every department of its activities, and to the stagnation and corruption in which Islam has been sloughing for the past 400 years. The essential principle of "Saracenic" art is pictorial, it being mainly directed to the decoration of wide extended plane surfaces, as of vast trellissed arbours, with deep glowing colouring, rich and warm reds and blues and yellow [gold]; sculptures, except in India, or mouldings being very sparingly used, or, where used, employed in many instances simply to enhance the effect of the colouring, as on the Alhambra. Yet this very "Arabesque" style of decoration, the essential feature of Saracenic art, was not an invention of the Arabs. It was known to the Greeks and to the Romans, and the Buddhists; it was greatly developed in the Byzantine [*i.e.*, the Græco-Romano-Perso-Buddhistic] period, and is seen in as complex elaboration in the "Palace of Nero," and the original cornice of St. Sophia—with the Buddhistic goose recurrent all along its flowing scrolls,—as in the Alhambra, or at Futehpur Sikri. Finally in regard to the technical methods of Saracenic art, and concentrating attention solely on its method of planning out ornamentation, *i.e.*, on its "arabesques," which is the question raised by Mr. Hankin's most interesting and suggestive discovery, it would appear that the Greeks habitually applied geometry to the perfection of decorative design. Decoration must, ultimately have a geometrical basis; and must be controlled by geometrical law, however unconscious the decorator may be of its operation. More than that, where decoration is attempted in conscious violation of geometry it rapidly lapses into indecorum and fatuity; furthermore there is good decoration that to the inartistic eye appears to be geometrical outlining pure and simple, but which really is entirely of artistic inception and draughtsmanship. And no doubt the Oriental craftsman of Saracenic art, including the Indian, kept up the tradition of the Greek use of geometry in the skeleton lines of their schemes of ornamentation; and we have indeed an obvious proof of this in Mr. Hankin's discovery. All this may be granted, and it cannot be gainsaid. Nevertheless, he [Sir George Birdwood] was convinced that the inspirations of artistic decoration came directly all from animated nature; and that the most inspired of the inventors of the decorative types derived from this ever springing fountain of artistic impulses and imagery, never had a thought of geometrical proportion in their minds. Much of what passes for geometrical ornamentation is due to the form imposed on it by the material used for its production, such, for an instance, as matting, wherein the graceful undulations of a snake work out in a crude "key pattern." The gradual conventionalisation of a design leads also to its gradually taking on more and more of a geometrical aspect; and again the decay of artistic inspiration, or of technical dexterity, will conduce to the deterioration of an ornament to the baldest of geometrical formulas. The women of the fisher folk in India universally mark their arms with a representation of four little fish smelling at each other's heads, and wagging their tails, by the right, to the four points of the heavens, E. S. W. and N. But in many parts of India this charming caste mark has become atrophied to four straight lines, arranged as an equal-armed cross, with a four-rayed star at their point of intersection, this star being formed by the meeting of the short reflex lines meant to figure the heads of the four little fishes; thus:—



Even where a decorative scheme is deliberately designed on a geometrical basis, it must not be conceived in a geometrical spirit, or draughted with geometrical implements. It must be inspired by artistic passion, and drawn with the fervid touch of the artist's own hand. All the geometrical ornament of the Mosque of Ibn Tulun is cut in the plaster with the hand; at the Alhambra the florid arabesques are in many places cast from moulds; and only the rare colouring of the Alhambra, and the grace of its cypriform pillars and arches, and its picturesque perspectives, serve to veil the mechanical monotony—as compared with freehand geometrical decorations of the "Mosque of Ibn Tulun"—of its "arabesques," after "Tulun," and before, "of its arabesques," a dash thus, when,—of its "arabesques." The life-giving touch of the artist's hand is everything in decoration, just as it is in painting and sculpture—in the domain of "fine art" as it is clumsily phrased; and for his (the Chairman's) part, he did not care to palter with that cardinal fact in art for any commercial consideratio

or advantage. The Code of Manu says that "the craftsman's hand is always pure." The artist craftsman's hand is in truth divine, for it is the hand of a Creator, and its work cannot be done by a rule and compasses, although it should be able to bear the test of the most searching — short of Procrustean stretching and docking—geometrical analysis and "registration."

Mr. LEWIS DAY said he would like to express his appreciation of the admirable way in which the author had shown the complicated designs side by side with the other designs; the manner in which the paper had been illustrated was an object-lesson in how such a paper should be delivered. Mr. Hankin had shown very plainly how the patterns might have been done, but whether they were always done in that way was quite another matter. The author had spoken as a mathematician and not as a designer; He (Mr. Day) could not imagine a designer always going to work in the manner described. There were so many ways in which the elaborate patterns which had been shown could be constructed. In demonstrating to students the construction of pattern, he had often discovered half a dozen plans on which a given drab design might with equal reason have been built, and it would be a bold man who would venture to say which was the actual way in which it was really done. In one particular case in which the author had explained how a particular pattern was made, he (the speaker) had discovered for himself many ways in which the same result could be arrived at, and the one shown was not one of them. There could be no possible doubt, however, as to the ingenuity of the author's explanations. The way in which Mr. Hankin built up sundry patterns from circles was not the way a designer would set to work. He had shown a cusped arch in which the cusping was supposed to be got out of circles; he did not believe any designer ever cusped an arch in that mechanical way. All patterns repeated on the geometrical basis, and geometric patterns exhibited the basis on which they were made. If all the elaborate lattice work on which intricate designs were set out were drawn on paper, it would be found that it was so complex that anybody—except perhaps the author, would get lost in the mist of lines; they must therefore look for some other way in which the patterns were formed. He had always felt very strongly that the simpler Arab patterns found in the Opus Alexandrium were built up of little triangles, &c., that was more likely the way in which the more elaborate work was done, and not by means of templates. The patterns, by the way, which the author had stated could be built up by putting together dodecagons could equally be arrived at by striking circles, and at the intersection of those circles drawing straight lines from intersection to intersection. It had to be remembered that when a designer drew those elaborate patterns he did not have the whole area of lines, &c., in front of him; he designed a little piece which he could keep in his mental grasp. He had only to keep that small unit in his mind; he knew what the effect of repeating the unit would be. Speaking as a practical designer of geometric pattern Mr. Day was conscious that the way in which the geometric designs exhibited were built up must have been in some more simple manner than the author had described; but, nevertheless, he was delighted at the ingenuity with which Mr. Hankin had pointed out how the things could be done, and he had shown him, as a student of the basis of design, different ways of arriving at the same results he had himself reached by another way. He proposed a cordial vote of thanks to Mr. Hankin for his intensely interesting lecture.

Prof. O. MULLER said the Chairman had stated that it was against his feeling as an artist that there should be a sort of geometrical basis for designs, but yet it must be allowed that the designs under discussion had a geometrical basis. There was a tendency for a pattern to be good or bad according as it approached more nearly to a proper geometrical basis. That was very apparent in many of the pierced screens in the buildings at Agra. Some of the buildings were built at a time when art was not good, or when good artists were not employed; a screen was fitted into a panel which it did not suit. But, on the other hand, if one visited a better building, built at a time when better artists were employed, it was to be noted that the screens fitted into the panels, and the patterns always connected up properly. There were in Agra some 30 or 40 known patterns of different pierced screens. The present Viceroy of India, Lord Curzon, had, to his lasting honour, taken up the question of the preservation of the wonderful buildings at Agra and elsewhere in India. He had not only caused them to be kept in good repair, but large works of restoration had been carried out. When Lord Curzon saw the tomb of Itimad-ud-Daula, he noticed that the balustrade of the marble pierced screens, which ought to have been along the top of the building, was wanting; as a matter of fact it was taken down just after Agra came into possession of the English, by some British General, and, as far as they had been able to trace, it was broken up and burnt to make lime. The Viceroy said he would like to see the screen put up, and the problem was how properly to restore the balustrade. From the minarets at the corners it was possible to judge how high it was, and from the marks still left on the edges, one could see where the pillars stood, and get at the size of the panels. It was found that the panels on one side were of different lengths, and consequently each pattern was different. From the methods which had been demonstrated that evening, it was comparatively easy for Mr. Hankin to find out which pattern would fit into the panel. Mr. Hankin submitted a design for the balustrade, which was put up on one side; the next time the Viceroy visited the place he

approved of it, and the balustrade had now been restored on all four sides. The author's method had therefore enabled the balustrade to be put up probably in exactly the same form in which it was there when it was unfortunately used for making lime and whitewash. The Chairman had made the remark that from his experience in Bombay, workmen made patterns by sitting quite close up to the work and having no construction lines; but the fact that the patterns could be produced by geometrical construction lines, and that they were in this sense the basis of the work, did not seem to him to lose any value. It might just as well be argued that because the circulation of the blood was unknown to the great mass of humanity that it did not exist. He therefore urged that when it was discovered that there was a geometrical basis for constructing such patterns, although some people might be able to make the patterns without knowing the basis, it did not prove that was not the basis on which the patterns were really formed, but simply that those people were unconscious of them. He thoroughly agreed with Mr. Day that probably artists and designers did not set to work by drawing little circles and geometrical patterns; they drew a free hand pattern, more or less, and evolved their scheme out of their inner consciousness; but when such designs were reproduced they had to be worked up in an office, *i.e.*, they had to be geometrically rectified; in the same way as when pictures were hung on the four walls of a room, some mechanical means had to be adopted to see that they were hung in a straight line. He therefore urged that in that manner mathematical methods of construction were probably employed to correct designs that were made by artists, even where the idea of a mathematical basis never crossed their minds.

The CHAIRMAN said he would like to say in regard to Professor Muller's remarks that it was high time steps should be taken to preserve the wonderful buildings at Agra. The palace in which Mr. Hankin made his discovery was sacrilegiously destroyed by the English in 1840 in carrying out some whimsical experiment in military mining, when it was practically blown up.

Mr. SYDNEY HALL said it was 30 years since he was in India with the King, when he hoped he admired as he ought to have done all the pierced marble screens he saw, but he remembered running away from them to see the natives diving from a very high wall into a deep pond, and sketching the scene. He was commanded on that occasion to draw many things, elephants, tigers, and temples, and he did his best, but he was happy to say that he was not commanded to draw one of the arabesques which had been shown by the author; if he had been he was perfectly certain he should have gone stark staring mad. If he ever went to India again he should take particular care to carry with him plenty of paper patterns of octagons, pentagons, heptagons, and dodecagons, and so possibly save himself from going mad.

Mr. PHENÉ SPIERS said that many years ago when he was travelling in Egypt he had occupied himself by endeavouring to find out the problems on which the mosaics were set-out in Cairo, and he arrived at a great number of solutions. The 12-sided star puzzled him a great deal, but he eventually arrived at very much the same result as the author. He found out that in the 12-sided star the pattern between the stars naturally depended upon the distance of the 12-pointed stars from one another, and that by placing them at varying distances combinations were arrived at which were not at first apparent in the design. He was inclined to agree with Mr. Day that a great many of the patterns shown were not based exactly on the geometrical system; in fact in many cases he thought they were probably the result of some instinctive feeling. He remembered some years ago, when he was superintending the execution of certain drawings for a great many beautiful buildings in India, Major Mant for whom the drawings were being prepared, said it was only necessary to set out the centres and axes of the panels, because the artists themselves would put in all the details. Professor Aitchison tells the story of an Englishman who was obliged during a violent storm to take refuge in a cave. Whilst he was there, a native came in with a small barrel in his hand and some materials, and drew on the ceiling one of the most beautiful designs that he had ever seen. He found out from the native the name and address of his parents in order that he might congratulate them on having such a skilled son, but the father replied that he looked upon the son practically as a dolt, because he only knew one design, whereas one of his brothers knew three or four patterns. There was no doubt the workmen had some instinctive power because they, without little intelligence, and certainly without any knowledge of geometry, produced the most beautiful designs. He believed that throughout India the workmen worked without a plan prepared by an artist as was the case in this country.

Mr. HANKIN, in reply, said a very important point was raised by the Chairman and Mr. Day as to the part played by free hand drawing *versus* geometrical design in the products of Saracenic art. He had studied the matter particularly at Futteypur-Sikri, and there geometrical methods seemed to have the day, whereas in other buildings in Agra and in all work produced at the present day geometrical methods had fallen into the background. One reason why he had ventured to bring the subject forward was because he was aware how completely the modern workmen in India were incapable of drawing the designs which Mr. Day said could be drawn instinctively or by using geometrical methods. They had completely forgotten these methods. In the old work of four centuries ago, there were extremely complicated arabesque designs, and no suggestion of a method had been brought forward by which they

could have been drawn except by the methods he had stated in his paper. In Futteypur-Sikri, not only were the geometrical patterns of that nature, but even the curvilinear designs were drawn to a great extent by means of a pair of compasses and similar geometrical methods. One of the curved outlines he drew by means of overlapping circles was based on a pattern in Futteypur-Sikri, and several other of the patterns in that place could be similarly constructed, and their solution was often a matter of extreme difficulty. It was the simplest example that he could find; in fact it was the only example sufficiently simple to have remained so long in his memory. In the later work in India, such as was found in the Taj and the Palace at Agra, graceful floral outlines were found, but to the best of his knowledge they were not drawn by means of a pair of compasses, but by the free hand guided by the free artistic sense of the artist. The buildings at Futteypur-Sikri were in a way archaic. The idea had often suggested itself to him that perhaps the artists who had to do with the buildings at Futteypur-Sikri were, when judged by English standards, people of low artistic powers; it was almost probable that they were incapable of drawing a graceful curve without some such mechanical method as a pair of compasses; but in the later work and in the higher products of Indian art, no traces were found of such a hindering influence. The fact that these geometrical methods were so completely forgotten in India was no hindrance to the production of artistic products. In their place it would be found that in Agra and its neighbourhood, the stone masons produced floral outlines of the greatest gracefulness and of the greatest suitability to the purpose they had in view. The fact that they had forgotten the old trammels of geometrical pattern was not a hindrance but a help to their work. If one went through the slums of Agra, or any other town in that part of India, the façades of houses would often be seen decorated with the most exquisite stone carving, which in his opinion equalled, if not surpassed, the more famous work of earlier days.

The resolution of thanks to Mr. Hankin for his exceedingly interesting paper was then put and carried with acclamation, and the meeting terminated.

THE FISHING INDUSTRY OF JAPAN.

The fish existing in Japanese waters are very varied and very plentiful; the most useful kinds in the northern part of the Empire are the herring, salmon, and cod. In the southern waters are found the sardine, anchovy, mackerel, bonito, tunny, shark, oysters, shrimps and prawns. The fresh-water fishery is not so important as the marine fishery, as there are few large lakes and rivers. In the warm seasons nearly the whole coast of Japan is washed by the Kuroshiwo (the warm current), or its branches. Thus the important migrating fish of the southern region are caught in the northern part of Hondo (main island), and also in Kokkaido, late in the summer or in the autumn. In the winter and spring, the Kuriles, Hokkaido, the north-eastern and north-western coasts of Hondo, are washed by the Oyashino (the cold current) or its branches. The number of vessels engaged in fishing on the Japanese coasts is said by the Imperial Fisheries Bureau of the Department of Agriculture and Commerce at Tokyo, to amount to over 400,000. Fish are sold fresh in enormous quantities in Japan, and fresh fish markets are extended year by year as the convenience of transportation increases. Considerable quantities of fish are also preserved, and many kinds of fishery products are utilised to a degree not equalled by many other countries. The most important seaweeds are "kombu," "amanori," "tengusa," and "funori." The greater part of the dried kombu is exported to China for food. Tengusa is made into a kind of isinglass called "kanten," and the kanten is also exported to China and other countries in large quantities. Amanori is made into sheets like paper and dried. It is called "hoshinori," and is considered a great delicacy. Funori is also made into large sheets like paper and dried. It is used only for starch. The methods of curing fishery products have greatly improved of recent years. This is especially seen in the canning business, which was introduced some thirty or forty years ago, and has grown considerably since the Japan-China war. Every year a little over five million pounds of fish of all kinds are preserved in tins. Brine-salting, or curing fish in strong brine, has been introduced recently, the salting of fish being formerly confined mostly to dry-salting. This has made it necessary to improve the Japanese salt industry in order to obtain a better quality of salt. As to the export trade, dried cuttle fish, dried "sea-ear," dried shark's fin, dried kombu and kanten are the most important articles exported to China. The exports of Japanese fishery products has long since been in a prosperous condition, the exports always exceeding the imports. The total exports to China have increased three million yen (£306,250) within the last ten years. Fish oils, including herring, sardine, cod-liver and whale oil, are exported to Europe in large quantities. Pisciculture in Japan includes the culture of fish, shell-fish, reptiles, and even algæ. Some of these have been cultivated from ancient times. Among these are the gold-fish, carp, eel, grey mullet, oyster, pearl oyster, turtle and amanori (an alga of the genus *Porphyra*). Most of them are cultivated in ponds, except shell fish and algæ which are reared in a bay or creek. The cultivation of amanori which is known only in Japan, is extensively carried on in Tokyo Bay and the Sea of Hiroshima-Ken. This seaweed is collected by means of the branches of trees or bamboos, driven into the sandy flats, which are exposed at the time of the ebb tide. To these, spores of the alga attach themselves and grow. These branches are renewed every year.

Funori is also cultivated in a primitive but effective method in some parts of the country. This is by simply throwing stones in the shallow water to give the alga a place to grow on. Carp culture is the most popular of the artificial fishing industries. It is carried on to a large extent in ponds, and sometimes even in rice fields. The culture of the soft-shell turtle is limited to one place in the suburbs of Tokyo, and requires very considerable skill. The artificial propagation of salmon has also been practised. In the year 1878 the Agriculture Bureau collected the eggs of salmon in certain rivers in Mügata-Ken, Nangano-Ken, Ibaraki-Ken, and Hokkaido, and distributed 356,500 fry into many rivers and lakes, and in 1890 the number had increased to 1,130,000 but without much success. There appears, however, to be one place which shows good results from this work. It is Lake Chuguji in Nikko, where there were no fish at all before the propagation of salmon. The quantity of fish in this lake is now so great that it supplies an abundance, and it affords excellent sport for anglers. A Fish Commission was appointed in 1893 to carry on more extensive scientific investigations relating to all branches of the fishing industry in Japan, and this Commission lasted until 1898. In that year the present Fishery Bureau was organised, and the work has been carried on more scientifically and systematically. While this work has been carried on by the Central Bureau, the Government has for a number of years encouraged the establishment of local experimental stations, and has given a bounty to each station. As a result there are now thirty-two experimental stations distributed among thirty-one prefectures. Fishing schools have also been started in different parts of the country. The Government also founded a school in Tokyo in 1897 called the Suisan Koskujo, or Fishery Institute. There are a few private Associations organised with the object of uniting those interested in the fishing industry, and of studying all important subjects in connection with the fisheries. Among these the Fishery Society of Japan is the oldest organisation. It was founded in 1881, and now has nearly five thousand members. This society publishes a monthly journal. There is another Association called the Society for Salt Industry of Japan which devotes itself to the improvement of the salt industry. It was established in 1896, and also publishes a monthly journal for its 1,500 members. Both of these organisations are situated in Tokyo.

THE ALCOHOL INDUSTRY IN FRANCE.

A Congress, recently held in Vienna, called attention to the many uses to which alcohol is adapted, especially for manufacturing a safe and cheap illuminating gas and for motors, for automobiles, &c. The inventors of certain novel processes for manufacturing alcohol have been interested in recent experiments tried in Denmark for distilling alcohol from peat at an estimated cost of one halfpenny per gallon. It is to be manufactured to replace gasoline and petroleum for illuminating purposes, and for motive power. France and Germany have, it is said, watched these experiments with great interest, knowing that if they are successful they will make an industrial revolution. The French Government has recently issued in the "Bulletin de Statistique et de Legislation Comparée," the official statement of the production of alcohol in France during 1903. It appears from this statement that 113,879 firms, whose names are registered in France, were engaged in making alcohol in that year. Of these 191 used farinaceous substances to produce the alcohol, 2 used potatoes, 289 used molasses and beets, 8,654 used wines, 7,526 used cider and perry, 92,783 used mash of different kinds, 4,363 used fruits, 153 used various substances, and 1 used glucose and the others sweetening materials. The 45 largest distilleries in France are situated in the departments of the Nord, Pas-de-Calais, Aisne, Somme, and Seine-et-Oise. Each of these distilleries turns out alcohol to the extent of 10,000 hectolitres (220,000 imperial gallons) annually. Since 1840 there has been a great change in the materials from which alcohols are manufactured; the quantity of pure brandy from grapes has diminished since the vines in the Cognac and Armagnac regions were injured or destroyed by the phylloxera, but it has increased since the American vines, grafted with French vines, have begun to bear. In 1903, of the total of 45,000,000 gallons manufactured, 20,000,000 were made from beets, 15,000,000 from molasses, and 8,000,000 gallons from farinacious substances. It would appear that a large number of distilleries for manufacturing alcohol from beets have been opened in France, on account of the rise in the price of alcohol and the fall in the price paid for beets at the sugar refineries. Some refineries have been turned into distilleries for making alcohol from beets.

EXHIBITION OF PROCESS ENGRAVING.

The Exhibition of Process Engraving, held in the Victoria and Albert Museum, which was opened to the public on Tuesday, the 14th inst., is a continuation of the Exhibition of British Engraving and Etching held in 1903. These like the previous ones of Lithography and Modern Illustration owe their initiation to the suggestion of the Council of the Society of Arts. This Exhibition is devoted to examples of photogravure, photolithography and kindred processes of reproduction by means of photography, including specimens of half-tone colour printing. The present Exhibition has been extended so as to include the productions of foreign countries in order that the development of engraving by photo-mechanical methods abroad may be compared with that in this country. The Bays 1 to 13 are devoted to the productions of Great Britain, while Bays 14 to 26 contain the work of foreign firms in Europe and America.

The first portion of the Exhibition is devoted to an historic section, which contains a number of objects of great interest. In the first case is an impression from a pewter heliograph plate, produced by Niépce in 1824 (a portrait of Cardinal Amboise), also MS. notes on Héliographie, 1827, 1829, and the first photograph fixed from nature, obtained by Niépce in 1827.

Specimens are exhihited of photo-engraving and photo-glyphic engraving by Fox Talbot, of Sir Joseph Swan's photo-mezzotint, of Paul Pretsch's mechanical processes, of Sir William Abney's papyro-type process, of the Woodbury process, also of various processes of photo-etching, photo-lithography, photo-zincography, and heliogravure. These historic specimens of the art are shown in the first three bays.

Examples of work in photogravure, collotype, and half-tone colour process have been exhibited by twenty-eight firms in England and Scotland. In several instances plates showing the progressive stages of the various processes are shown.

The London County Council School of Photo-engraving and Lithography, and the Polytechnic School of Photography show specimens of the works executed in their schools. In one of the cases are materials used in the tri-colour process, and chemicals used in collotype. In the foreign department the following countries are represented:—Austro-Hungary, Belgium, Denmark, France, Germany, Holland, Italy, Russia, Spain, Sweden, Switzerland, and the United States of America. Some specimens of Japanese printing, selected from the Art Library of the Victoria and Albert Museum, are also shown.

There are a considerable number of reproductions from pictures both in the English and Foreign departments, and some autogravures from water-colour paintings among the exhibits from Holland are worthy of special attention. These can be compared with the original drawings. In several other cases the original paintings are placed in juxtaposition to the reproductions.

Major-General J. Waterhouse, a member of the Committee of Advice, has contributed a valuable introduction to the catalogue, in which he explains the principles of photo-mechanical processes, and gives information respecting the dates of their introduction and development.

The Exhibition will remain open until the end of June.

GENERAL NOTES.

International Congress on Technical Education.—The Permanent Committee of the Congress have accepted an invitation for the holding of the next meeting at Milan in 1906. The date has not yet been fixed, but as it is also proposed to hold at Milan in the same year an International Congress of Commerce and Industry, it is probable that the dates for the two Congresses will be arranged so that they may take place about the same time. The Committee have had before them various suggestions for the holding of another meeting in England, and though nothing definite has yet been fixed, they are not without hope that the meeting after the one at Milan may be held in this country.

Metric System of Weights and Measures.—A Parliamentary paper just issued gives the latest information as to adoption within the Empire of the metric system of weights and measures. Approached on the subject, the Government of New Zealand replied that "until the British Government and that of the Dominion of Canada adopt the system, it would, they consider, be inadvisable for this colony to move in the matter." Upon being communicated with, the Dominion Privy Council approved a minute expressing the willingness of the Government to introduce legislation to legalise the metric system "at such time as may be agreed upon between His Majesty's Government and the various units of the Empire." Something has already been done to encourage the use of such a system in Canada. By 34 Victoria (chapter 24, 1871) it was provided that for the promotion and extension of the internal as well as of the foreign trade of Canada, and for the advancement of science, it was expedient to legalise the use of the metric system of weights and measures, and since that date weights and measures of the metric system have been used in Canada, but almost enclusively in connection with scientific investigation. Moreover, the Department of Education has distributed to educational institutions nearly 500 sample sets of the metric system, and has also equipped the principal weights and measures offices with standards of the system referred to in order that an inspection of metric weights and measures may be made whenever the demand therefore arises.

Industrial and Technical Education in Malta. — An industrial school was opened in March, 1903, and is now being conducted by the Salesian Fathers at the request of the Government, on whom the whole of the cost of the maintenance falls. The Technical and Manual School, in which drawing, modelling in clay, plaster-casting, stucco-work, and wood-carving are taught, has been in existence for some years. The attendance is voluntary, and no fees are paid. The results obtained hardly justify the expenditure involved. On this account the school is to be closed shortly, to be replaced by a development of the technical education which is at present given in the elementary schools.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock :—

March 22.—"The Present Aspect of the Fiscal Question." By Sir Charles Malcolm Kennedy, K.C.M.G., C.B. Sir Westby Perceval, K.C.M.G., will preside.

MARCH 29.—"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P. R. C. MUNRO-FERGUSON, M.P., will preside.

APRIL 5.—"Ancient Architecture of the Great Zimbabwe." By RICHARD A. HALL.

APRIL 12.—"The use of Wood Pulp for Paper Making." By S. CHARLES PHILLIPS, M.S.C.I.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

APRIL 6.—"The Prospects of the Shan States." By SIR J. GEORGE SCOTT, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States. THE MOST HON. THE MARQUIS OF BATH, will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MARCH 28.—The Manufactures of Greater Britain. —II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MARCH 21, 8 p.m.—"West Country Screens and Rood Lofts." By F. BLIGH BOND, F.R.I.B.A. G. F. BODLEY, R.A., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

HERBERT LAWS WEBB, "Telephony." Four Lectures.

LECTURE II.—MARCH 20.—*Telephone Lines.*—Characteristics of telephone current—Necessity for metallic circuits—Overhead lines—Types of telephone line construction—Telephone cables—Evolution of special type of cable for telephone work—Conduits—Distribution—Aerial cables—Means of increasing range of transmission—Long distance telephony.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Herbert Laws Webb, "Telephony." (Lecture II.)

British Architects, 9, Conduit-street, W., 8 p.m. Papers on "Decorative Painting" by Sir William Richmond, Mr. Alfred East, and Mr. Solomon J. Solomon.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Warren Upham, "The Nebular and Planetesimal Theories of the Earth's Origin."

TUESDAY, MARCH 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. F. Bligh Bond, "West Country Screens and Rood Lofts."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. Dalby, "Engineering Problems." (Lecture I.)

National Service League, Caxton-hall, Westminster, S.W., 5½ p.m. Mr. H. Birchenough, "The Industrial Advantages of Universal Naval and Military Training."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by Lord Brassey, "Shipbuilding for the Navy."

Statistical, in the Theatre of the United Service Institution, Whitehall, S.W., 5 p.m. Mr. W. N. Shaw, "The Seasons in the British Isles since 1878."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Colonel A. M. Murray, "Comparison Between Continental and English Methods of Military Education."

WEDNESDAY, MARCH 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir Charles Malcolm Kennedy, "The Present Aspect of the Fiscal Question."

Geological, Burlington-house, W., 8 p.m.

Dyers and Colourists (London Section), 608-600, Birkbeck Bank Chambers, Holborn, W.C., 7½ p.m. 1. Mr. F. W. Colin Robinson, "The Dyeing and Finishing of Leather for Bookbinding; with remarks on Preparatory Manufacturing Processes." 2. Mr. H. Ley, "A Dyeing Drum Door, removable and replaceable without stopping the Drum."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, MARCH 23...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Mr. Thomas G. Jackson, "The Reasonableness of Architecture." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. E. H. Rayner, "The Effect of Heat on the Electrical and Mechanical Properties of Dielectrics," and "The Temperature Distribution in the Interior of Field Coils." 2. Mr. R. Goldschmidt, "Temperature Curves and the Rating of Electrical Machinery."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 24...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m., Sir Oliver Lodge, "A Pertinaceous Current."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. C. T. Gardner, "The Wanki to Victoria Falls Section: Victoria Falls Railway." 2. Mr. H. S. Coppock, "Design of a Double-Line Plate-Girder Railway Bridge."

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Mr. A. N. Wilson, "Sketch Plans and Working Drawings."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Pender Electrical Laboratory, University College, Gower-street, W.C., 5 p.m. 1. Mr. W. C. Clinton, "Note on the Voltage Ratios of an Inverted Rotary Convertor." 2. Mr. G. B. Dyke, "The Flux of Light from the Electric Arc with varying Power Supply." 3. Prof. J. A. Fleming, "The Application of the Cymometer and the Determination of the Coefficient of Coupling of Oscillation Transformers." 4. Exhibition of Cymometers and other Instruments.

SATURDAY, MARCH 25...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Electrical Properties of Radio Active Substance." (Lecture III.)

Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

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FRIDAY, MARCH 24, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 27, 8 p.m. (Cantor Lecture.) HERBERT LAWS WEBB, "Telephony," Lecture III.

TUESDAY, MARCH 28, 4.30 p.m. (Colonial Section.) HON. WALTER HARTWELL JAMES, K.C., Agent-General for Western Australia, "The Manufactures of Greater Britain. II.—Australasia."

WEDNESDAY, MARCH 29, 8 p.m. (Ordinary Meeting.) RIGHT HON. SIR HERBERT MAXWELL, BART., M.P., "British Woodlands."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 20th inst., Mr. H. L. WEBB delivered the second lecture of his Course on "Telephony."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, March 21st; G. F. BODLEY, R.A., in the chair.

The paper read was "West Country Screens and Rood Lofts," by F. BLIGH BOND, F.R.I.B.A.

The paper and report of the discussion will be published in a future number of the *Journal*.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1905 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before the 1st April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate ot the Institute of France, For.Memb.R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For.Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For.Memb.R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (now Lord Masham).

In 1887, to HER MAJESTY QUEEN VICTORIA.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S.

In 1899, to Sir William Crookes, F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to His Majesty the King.

In 1902, to Professor Alexander Graham Bell.

In 1903, to Sir Charles Augustus Hartley, K.C.M.G.

In 1904, to Walter Crane.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 22, 1905; Sir Westby B. Perceval, K.C.M.G., Member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Flack, Albert, 264, Borough High-street, S.E,

Pierera, A. A., Alexander Institute, Hyderabad, Deccan, India.

The following candidates were ballotted for and duly elected members of the Society.—

Adams, John Henry Maudslay, Broughton Cottage, St. James's-road, Waverley, Sydney, New South Wales, Australia.

Davis, Joseph Edward, 24, Maple-road, St. Thomas, Exeter.

Dewhurst, Wynford, Chelmscote, Leighton Buzzard.

Griffith, Samuel Barnes, 8, John-street, Adelphi, W.C.

Holding, Edwin, Balmain, New South Wales, Australia.

Kilburn, Bertram Edward Dunbar, M.A., Assoc. Inst.C.E., 6, Stanhope-street, Hyde-park, W.

Lawson, Eric St. John, Bangkok, Siam.

Medley, Charles Powis, A.M.I.Mech.E., 103, Worship-street, E.C.

Mocatta, Elkan B., 31, Great Cumberland-place, W.

Munton, Frederick Thomas, F.C.S., Beaconfield, Weston-road, Runcorn.

Newcombe, Robert William, 9, Groveland-avenue, Hoylake, Cheshire.

Ross, James William George, 143, Mitcham-lane, Streatham, S.W.

Tepowa, Adebiyi, Customs House, Calabar, West Africa.

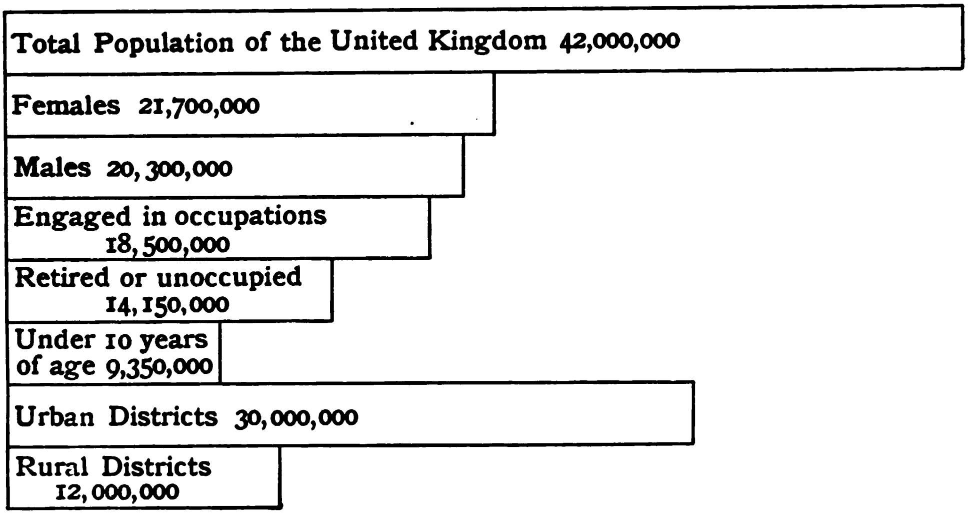
The paper read was—

PRESENT ASPECTS OF THE FISCAL QUESTION.

By Sir Charles Malcolm Kennedy, K.C.M.G., C.B., F.S.S.

Since the previous paper was read here on the 2nd of December, 1903, the fiscal question has formed the subject of debates in Parliament, of important public speeches, and of many interesting and valuable publications. Blue-books issued by the Board of Trade, the Board of Agriculture, and the Commissioners of Customs; the Census Returns of 1901; and Reports presented to Parliament by the Foreign, Colonial, and India Offices, have further elucidated the subject, which is now more clearly seen to comprise various and complex subdivisions. Our inquiry and aim is to investigate the facts thoroughly and sincerely, and then to endeavour to trace the conclusions to which they lead—to consider the interests of the Empire, the needs of the active worker, and the things with and upon which he works. We have to consider in the first place the three divisions of commerce—the home, foreign, and carrying trades—and the financial aspect of the case. Since December, 1903, the publication of the full statistics of the Census of 1901 shows the numbers, and the occupations, of the people whose interests are affected by the fiscal question. These are seen in Diagram I. The per-centage of increase or decrease in the intercensal period, 1891-1901, was:—England and Wales + 12·2; Scotland + 11·1; Ireland − 5·2; the increase for the United Kingdom being 9·9.

The population, occupied and unoccupied, above ten years of age, was 32,335,350; engaged in occupations, 18,500,000; retired or unoccupied, 14,150,000; under 10 years of age, 9,350,000. The analysis of occupations is seen in Diagram III. (see p. 484).



I.—Population of the United Kingdom.

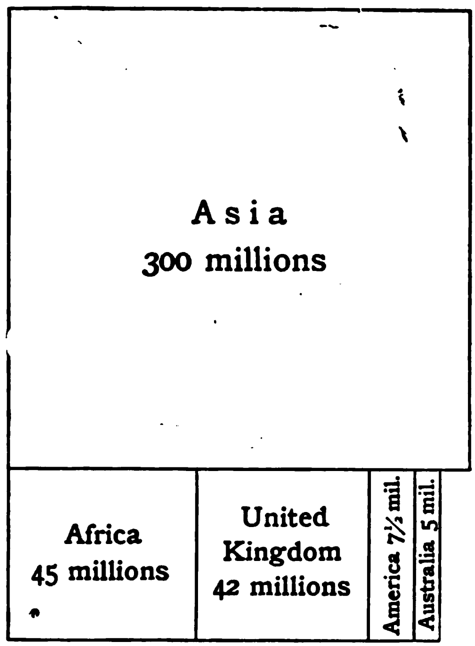
There is an increase between 1891 and 1901 in the number of persons engaged in the occupations enumerated in Diagram III., except in the following classes:—

4. Domestic services—diminution..	39,229
7. Agriculture—diminution	158,472
8. Fishing—diminution	3,717
18. Textile fabrics—diminution	57,860
22. General dealers and workers—diminution..................	194,473

The diminution in Class 4 is largely owing to "bad times" in 1901; the decrease in Classes 7 and 18 is serious in its industrial aspect; the decrease in Class 22 is partly owing to greater care in 1901 in bringing persons into definite headings of occupation. It is obvious that the economic interests of the persons engaged in industrial occupations are by no means uniform; and to some extent are opposed. A country where occupations are thus distributed is not a protectionist country. It requires in many respects an abundant importation of goods from abroad, at moderate prices. Between 1891 and 1901 in England and Wales the urban population increased 12·2, and the rural 2·9 per cent.

In 1901 the British Empire comprised "more than one-fifth of the land surface of the globe." The distribution of the population is seen in Diagram II.

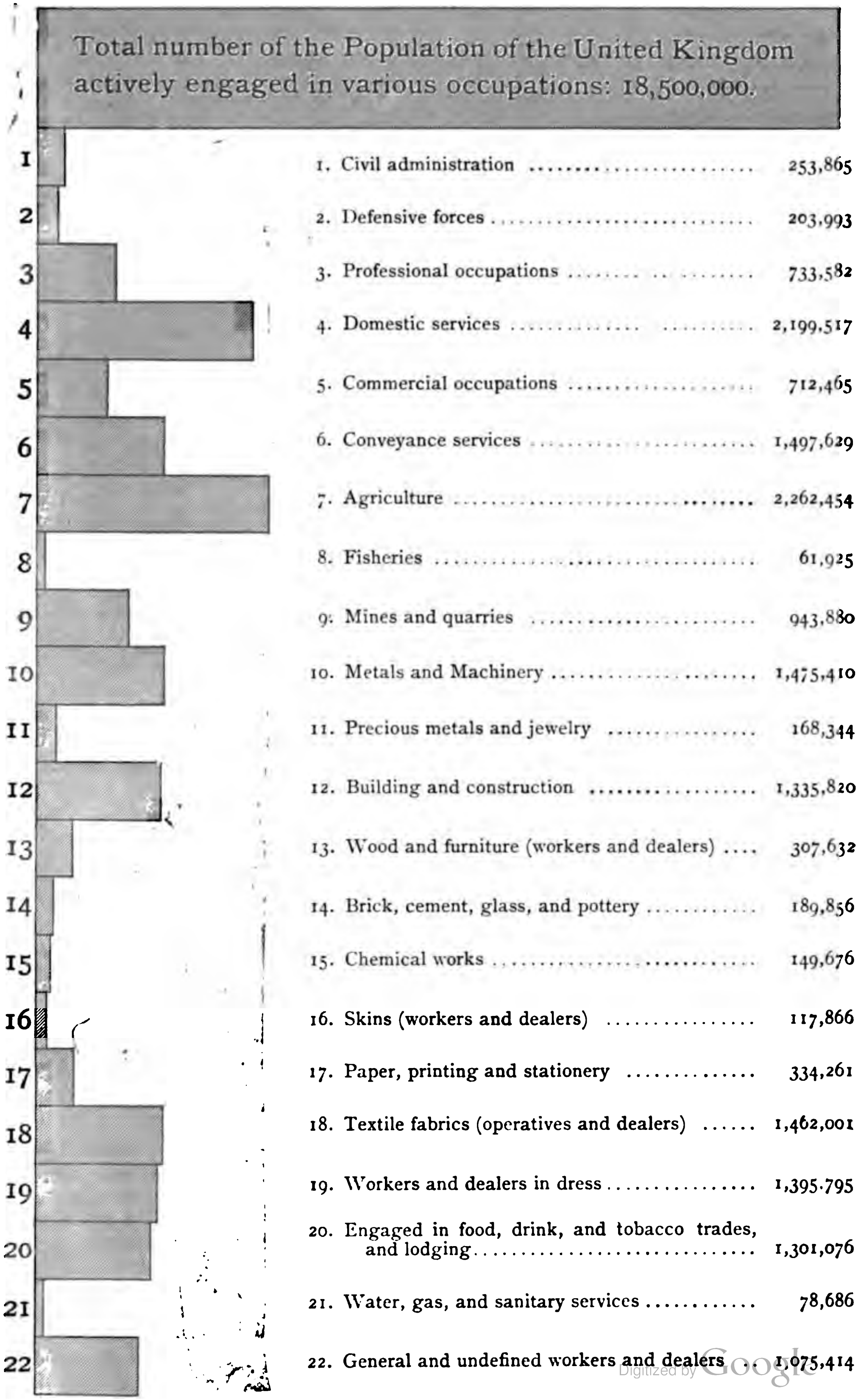
The diagrams show:—First, population of the United Kingdom; secondly, population of the whole Empire; and thirdly, occupations of the people. The Board of Trade statistical charts prepared for the St. Louis Exhibition, which are in the Society's library, show fluctuations of employment, wages, and prices; and that moderate Customs' duties do not increase the



II.—Population of the British Empire, which comprises "more than one-fifth of the land surface of the globe," with a population of 400,000,000: Census Report, 1901.

cost of commodities. Three preliminary conclusions result from this survey of the United Kingdom and the Empire:—

1. Fiscal policy should not have exclusive



III.—Occupations of the People according to the Census of 1901.

reference to the United Kingdom: the interests of the whole Empire require attention.

2. *Industrial* occupation and work give direct employment to a relatively small portion of the people of the United Kingdom.

3. The United Kingdom has become, to a large extent, a residential country.

These facts enable us to dispose of two assertions on which stress has been laid in the fiscal controversy. One speaker asserted that "probably 7-10ths of the people are producers first of all, and can only be consumers to the extent they produce." Another speaker asserted that "the working men were 7-10ths of the entire nation." In the light of the information now afforded these statements carry with them their refutation.

Turning next to main considerations bearing upon the several divisions of commerce—

1. *The Home Trade*.—There are no statistics which show the home trade of different countries. It will be evident that this must be the case; there are no means of measuring the consumption of commodities. Reference has been made in the measurement of internal trade, to clearing house and railway returns, bank deposits, and income-tax yields, but these figures do not supply an exact criterion of the amount and value of the internal trade. Sir Robert Giffen says ("Economic Inquiries and Studies," vol. 2, p. 405)*:—

"The bulk of the exchanges in every community is, and must be, not between the community and the outside world, but among the members of the community themselves. The main quantity of business is in fact always local. The members of the community mainly work for each other, and exchange services with each other."

The second great division of commerce, the *export trade*, is closely connected with the main questions which are comprised in the fiscal discussion. As, however, the trade relations of foreign countries must be considered in connection with our export trade, this division of the general subject will be more conveniently treated in a separate section of this paper.

The carrying trade, the third branch of commerce, which is of very great importance to British interests, resembles the home trade in the absence of a definite measurement of its extent and value. The Board of Trade Bluebook, No. 1761, of 1903, p. 101, estimates the aggregate gross earnings of British shipping at "about 90 millions." It is not possible now to attempt to apportion the earnings of the shipping trade, and the remarks on the subject must be limited to the traffic more directly concerned with the fiscal question — namely, the carrying and transit trade. This is a lucrative branch of shipping business. There is, however, obviously no special reason why it must necessarily be conducted at British ports. The course of this traffic depends largely on trade customs and habits, and on convenience. Freedom from irksome formalities, and facilities in financial transactions, are the leading facts which at the present time secure a very large transhipment and call business at British ports. The circumstances of this traffic are grounds for caution in fiscal changes.

Financial operations must also be borne in mind. London is now the banking centre of the world. Financiers of almost all countries keep money in London. It is often the easiest and cheapest course, in transacting international business, for a merchant in country A to make a payment due in country B by giving his creditor in country B a bill of exchange on London, instead of effecting payment by a direct remittance. Steadiness in the Bank of England rate, and in the value of the London sterling bill of exchange, are very important factors in the financial mecanism of the world; and for British interests. At the present time the international money market determines, to a large extent, the commercial and financial prosperity, and the *status* of nations. Business follows capital, credit, and capacity; it is often dependent upon banking houses which aid business transactions, not only with money advances, but equally by their ability, experience, and knowledge. The adequate supply of cheap money, and the growth of banking deposits, render funds available for profitable use at home and abroad. Local extravagance and bad finance have latterly injured our home investments and trade, and have diminished national wealth. *The Times* financial supplement of September 12th, 1904, contains an important statement relative to profitable investment abroad. It is to be remembered, however, that while foreign investments form an important part of the financial operations of this age, they are not reproductive for our national resources in the same way as home business. Their permanence and stability are also less secure. Accordingly, on financial as well as on other grounds, caution is needed in regard to fiscal changes in the United Kingdom.

* Subsequent quotations are taken from this volume, unless another work of Sir Robert Giffen is mentioned.

The foreign trade in its relation to the fiscal question was considered at some length in the paper of December 2nd, 1903. The Board of Trade Blue-book, No. 2337 of 1904, pp. 379-94, contains fresh information, which renders it necessary to advert again, as briefly as possible, to this part of the subject. This second Blue-book, on British and Foreign Trade and Industrial Conditions, fully maintains the high standard of the first volume. The completeness and scope of the information afforded, and the combined fairness and reticence with which controversial topics are treated, add to the public service which the Board of Trade render by these publications. The division (established in the Blue-book of 1903) of countries designated as "Protected" and "other markets" is maintained in the new volume, and completed to date.

The estimated average *ad valorem* equivalent of the import duties levied by the under-mentioned foreign countries and British possessions on the principal manufactures imported from the United Kingdom:—

	Per cent.		Per cent.
Russia	131	Roumania	14
Spain	76	Belgium	13
United States ..	73	Norway	12
Portugal	71	New Zealand ..	9
Austria-Hungary ..	35	Japan	9
France	34	Turkey	8
Argentine Republic	28	Switzerland ..	7
Italy	27	Australia	6
Germany	25	South African Customs Union (Preferential Tariff)	6
Sweden	23	China	5
Greece	19	Holland	3
Denmark	18	British India ..	3
Canada (Preferential Tariff)	17		

While it is not claimed that these calculations are wholly satisfactory, it may at least be stated with some confidence that the countries and colonies included in the inquiry should be ranged approximately in the above order, as regards the comparative level of their import duties on the principal manufactures which are exported from the United Kingdom.

It would not, however, be justifiable to conclude from the above figures that the Customs tariffs of the various countries are ranged in the same order as regards their comparative protective efficiency. The protective effect of a tariff is not necessarily proportionate to the average level of the duties, but also depends on many other factors, such as the comparatively advanced or backward state of the home industries protected. A 25 per cent. duty in Germany may give as complete protection to a native industry as a 100 per cent. duty in a more backward country. A high duty may have no protective effect, if the article to which it applies happens not to be manufactured in the country in question. (P. 292.)

Passing over tabular statements in this Blue-book, which are of great interest and importance, the facts bearing upon our enquiries are—(1) that the United Kingdom is the most important market for the products of France, Germany, and the United States; (2) that the export trade of these three countries has experienced less impediment from the tariffs of other protectionist countries than has been the case with the export trade of the United Kingdom; (3) that these tariffs place more impediment in the way of British exports, which consist mostly of manufactures, than of exports from countries in which manufactures form a smaller element; (4) as regards trade to "identical neutral," as well as the "protected," markets, "the rate of increase is seen to be greatest in the case of the United States, followed by Germany, the United Kingdom, and France." There is, however, another point to be borne in mind, tariffs are not the only reason which has diminished British trade or prevented its growth. Improvements of machinery, and the extended use of steam power, as well as sound technical education, have, during the last half century, equalised the industrial efficiency of manufacturing countries. Skilled operatives, managers and teachers, are now established there, and the leading firms are controlled by their founders or immediate successors, and not by more distant followers. New appliances and improved routes of communication favour the productions of foreign countries which now largely supply their own wants, and offer in neutral markets goods suited to the needs and fashions of the people—often more appropriate than British goods. There are no grounds for anticipating that protectionist nations will, of their own accord, alter their fiscal systems or customs regulations in order to facilitate British trade. If we wish alterations for this purpose, we must, ourselves, take action. The principal openings for real expansion in our export trade are to be found in neutral and Colonial markets. It is, therefore, a matter of primary importance to our manufacturing population, as well as to our national interests, that the actual conditions of these markets shall be fairly and dispassionately made known. The "Statistical Abstract of the British Empire," published this month, is another of the very instructive compilations issued by the Board of Trade, the study of which is essential for obtaining adequate information respecting Colonial trade.

The values of imports and exports taken

alone do not afford complete evidence as to the amount of trade. The quantities of goods must likewise be considered. The limits, and the primary object, of this paper make it necessary to omit the statistics on which the examination of this part of the subject is based. The result proves that the increase in the value of exports in 1904 over 1903—£64,081,514 as compared with £55,267,497—is to be attributed to enhancement of price, and not to an increase of trade. The assertion that a large increase of trade took place in 1904 is erroneous. As regards the general question often referred to in fiscal discussions of the excess of imports over exports, Mr. Smart, in "The Return to Protection," reckons (p. 41), that the values of the total imports of the commercial nations of the world is approximately £2,516,000,000, and of their exports £2,292,000,000. There is thus a debit balance in the trade of the world of about £224,000,000. Consequently, the nations of the world are either losing instead of gaining by their trade, which is contrary to fact; or else this apparent deficit is balanced by other payments—the largest items, in our case, being earnings of the shipping trade, and income from external investments.

The industrial position of the country is directly connected with the trade questions adverted to in the preceding sections of this paper. It is very fully set forth in the memoranda and statistics relative to economic matters contained in the Board of Trade Bluebook, No. 2337, of 1904. An admirable summary is published in the Society's *Journal* for the 24th of February, 1905. It is sufficient for the purposes of this paper to refer to the article on the "Distribution of the World's Industrial Population" contained in that number of the *Journal*, and to add the following Tables, giving this information from the German standpoint. *Industrie Zeitung* of Berlin, in October, 1904 (translation in the *St. James's Gazette* of October 26), stated as follows the proportion of persons employed in the three great subdivisions of employment:—

1. *Agriculture, Horticulture, and Forestry.*

Italy	59·4	United States	35·9
Hungary	58 6	Holland	30·7
Austria	58·2	Belgium	21·1
France	44·3	Scotland	12·0
Germany	37·5	England and Wales	8·0

Russia does not appear in this list; but would probably come first in this category.

2. *Manufactures and Mining.*

Scotland	60·4	Germany	37·4
England and Wales	58·3	France	33·6

Belgium, Holland, and Switzerland—more than one-third of the working population are so employed.

United States .... 24·1

3. *Commerce and Transportation.*

Holland	17·2	Germany	10·6
United States	16·3	France	9·4
England	13·0		

The Fiscal Outlook in Foreign Countries.

There does not seem to have been any changes in the Customs tariffs of foreign countries in 1904, detrimental to Britain; but the outlook in the near future is unfavourable. The new German tariff, which will come into force on the 1st of March, 1906, accentuates the recent commercial policy of the German Empire, and will be the controlling influence in central Europe during the next twelve years. According to newspaper reports, the French Government are now making an enquiry as to the probable effects of this action upon French trade. The commercial advisory committee of the Board of Trade reported on this new tariff in the following terms:—

"It is proposed to increase the German import duties on the great mass of articles in which the trade of this country is interested by rates varying from 25 to 100 per cent. and over. In some instances, as in the case of various classes of machinery, the percentage increases on present rates reach almost startling proportions. Moreover, the statement, as will be seen, mentions a number of articles which, although previously free of duty, are now to be charged burdensome rates. And it has to be added that where the proposed increases in duties fall short of the level of 25 per cent., the articles are, in most cases, already supporting as heavy Customs charges as they can well bear. To attempt to particularise in respect of the rates for individual articles would virtually involve a recapitulation of the whole statement which, we think, should be placed in its entirety before the German Government with a view to obtain reductions in the proposed rates of duty on the articles included in it.

"But it is not alone in respect of increased duties that the new tariff is viewed with disfavour by our commercial and industrial community. It has to be pointed out that it proposes to enact an extensive sub-division of some of the more important categories of the existing tariff, and that this, in actual practicc, will require intricate calculations, greatly increase the labour of German importers and Customs officials, and unduly impede the course of trade, besides giving occasion for innumerable disputes between importers and the authorities."

On the 30th January, new commercial treaties between Germany and Austria-Hungary, Belgium, Italy, Roumania, Russia, Servia, and Switzerland, were published at Berlin. *The Times* correspondent there, on that date, said that under these treaties the Customs tariffs of these countries, respectively, will also be raised. The commercial treaty system of 1905 will thus possess conditions of permanency. It would seem that the German Government have disregarded the representations of British commercial bodies, and of our Government, asking for some modification of the new arrangements. *The Times* correspondent makes the following remarks respecting the bearing of the new duties in Germany, on British trade:—

"The new industrial duties are of the greatest interest to England. On the whole they represent for the textile industry a considerable increase in protection for the German producer, especially as regards wool and cotton. In general, it is the finished products rather than yarns, which are subjected to heavier duties, amounting in some cases to an increase of 30 to 50 per cent. In the case of flax and jute yarns there is very little difference, and in some cases there even appears to be a reduction. For leather goods there is a large increase, confined to finished articles, and amounting in the case of shoes to a difference of from 7 to 12 per cent. on the present duties. In the case of paper and paper goods it is difficult to institute a comparison, since the different categories of these goods are arranged on a new system. On the whole, where there were formerly two or more sets of duties according to quality or finish, a comprehensive duty is now imposed, which is higher than the lowest scale and in some cases as high as the highest. Under certain headings there is a considerable increase. In the case of iron goods the new classification is so elaborate that a comparison could only be instituted by experts. Indeed, it is a feature of the new treaties that more effective protection for German industries is frequently secured by minute specification and by the imposition of higher duties only in cases where foreign competition has already made itself felt.

"Under the heading of machinery the system of admitting certain important materials for shipbuilding without duty is maintained, as in the case of ships' engines and boilers. On the other hand, industrial machinery and mechanical tools, which Germany now manufactures with considerable success, are subjected to heavier duties. Motor carriages and bicycles will be charged for according to weight on a scale ranging from 100 marks (£5) to 15 marks (15s.) per 100 kilogrammes. Bicycles and finished sections of bicycles will be charged 100 marks (£5) per 100 kilogrammes.

"It is a matter of urgent necessity that the new German industrial duties should be subjected to careful scrutiny in England, with a view to seeing whether they can be accepted, or whether protest, and eventually retaliation, would be advisable. The absence of a treaty of commerce between Great Britain and Germany gives the British Government a free hand in this regard."

The fiscal policy of Germany, and of other countries, is directed to secure for home manufacturers the command and supply of the home market. The people of the country and the Legislature are well aware that *high* Customs duties increase prices at home. But this policy increases shipping and trade business, and it secures continuous employment for the working classes. The continuous running of factories and a maximum output also reduce the cost of production. Whatever opinion may be entertained respecting the merits or demerits of the protectionist policy adopted in Germany in 1879, since then, and especially since the conclusion of German tariff treaties, great and rapid progress has taken place in most branches of manufactures and commerce. The Government act upon this policy as part of their plans for the development of national industry and their position among nations. The proceedings of the German Government in Turkey are an object-lesson in this respect, and have been summed up in *The Times* in these words:—

"In 1882 German exports and imports to and from Turkey were 5,900,000 and 1,200,000 marks respectively. By a gradual and steady progression they had risen to 43,300,000 and 36,600,000 marks in the next twenty years. And German interests—even financial interests—in Turkey are not all, there is good reason to believe, in the hands of individuals or of corporations supported by the State. In at least one important enterprise—the Constanza-Constantinople Cable Company—it is reported that more than half the shares are held by the Imperial Ministry of Posts and Telegraphs." (Feb. 9th, 1905.)

The policy of the Dingley tariff in the United States has been well explained in a recent letter of Mr. Shaw, the Secretary of State:—

"If I understand the Dingley law correctly, it, in effect, says to the American producer, artisan, and farmer, You shall have protection within the American market. Whoever invades the American market must pay duty upon the articles with which he makes invasion. But the same law says to the American exporter, If you will employ American labour, pay American wages, you shall have every possible advantage in your effort to reach foreign markets. You shall have free iron, free lead, free wool, free hides, free wheat, free everything except labour. There must be neither contract labour nor coolie labour employed, even in the manufacture of

goods for export. American wages must be paid so that the American labourer shall be able to put a roof over his family, unpatched clothes upon his children, and have meat upon his table at least once each day." (*Times* Commercial Supplement, Feb. 13th.)

Recently, a new phase in the development of industrial business has taken place. For several years past, foreign manufacturers have acted together in distant markets and in exhibitions. This was joint action or *collectivité*. The idea, carried into general business, became combinations of financiers or manufacturers formed under the designation of kartells or trusts. All trade demands are somewhat uncertain, and when supplies exceed their demands, the existence of a kartell or trust enables manufacturers to dispose of their products by mutual agreement, without competition between themselves, and without curtailing employment. Rightly acted upon, such combinations may be useful, both to principals and operatives.

Serious abuses, however, have arisen from combinations of capitalists and manufacturers, directed against either the public generally, or their own workpeople, especially when they withhold supplies of goods from the market. President Roosevelt has pointed out the pernicious effects of the use of vast wealth, exerted in combined action, to build great power with the object of controlling the Legislature for the benefit of individual capitalists, and to further their aims. This action of trusts and kartells is the worst outcome of a protectionist system. These combinations, in their operations in foreign markets, confer insidious temporary advantages. For example, in the present conditions of industrial enterprises, the British market being open, the foreign exporter can rely on it for taking his surplus stocks—a very important point in trade—with safe and early payment, on terms more or less advantageous to the exporter. The buyers of these particular goods may benefit at the time, yet such sales brlng uncertainty into commercial business, and endanger English manufactures. Liability to an influx of competing goods on these terms paralyses the power of managers and principals to carry on works; while loss of employment and bitter suffering befall the best classes of workmen and their families. A general sense of insecurity prevails. Then, as to the entry of British capitalists into protected areas, it is said that "for every £100,000 that the protectionist policy causes to be sent from England to be invested in American factories, it probably keeps away at least £1,000,000 that would otherwise have been sent there to be invested in railways and agriculture" ("Riddle of the Tariff," p. 32). But this statement is not an argument. The £100,000 investment is assumed to be a fact; the £1,000,000 is only stated "probably," a mere hypothesis.

Some persons seem to deny the fact of the dumping of foreign goods—*i.e.*, the sale below the normal market rate. Mr. D. A. Thomas, M.P. (whose opinions I have already quoted, and whose valuable paper on the coal trade obtained the Guy medal of the Royal Statistical Society), said at Merthyr on the 4th of December, 1904, "I am prepared to agree with you that some of the want of employment is due to dumping." Mr. Keir Hardie, M.P., said at Dowlais, on the 26th of September, 1904, "that there has been dumping from America and Germany was unquestionable." Mr. Cripps, M.P., in a speech on the 5th of March, 1904, said, "The necessity of some immediate effective action was emphasized by the operation of the economic 'law of surplus,' which in ordinary language had been familiarised under the term 'dumping.'" Mr. Thomas Spittle, of Newport, gave in *The Times* of the 30th of January, 1905, recent instances of the dumping of German goods to the detriment of South Wales industries. It is thus seen that there are at the present times various questions connected with our foreign trade which ought soon to be determined, and which are of very real importance. Outlets are needed for our exports, while, as regards imports, an abundant and cheap supply of goods does not necessarily imply the cheapest supply at abnormal rates owing to exceptional disturbance of the ordinary course of trade.

Certain main subjects directly bearing upon the interests of the United Kingdom have now to be considered—namely, agriculture, including food supplies, and suggested remedial measures; Colonial preferential treatment; taxation generally, and Customs duties.

Agriculture.

The returns of acreage and live stock issued by the Board of Agriculture and Fisheries, enable the following comparison to be made—for the United Kingdom, including the Isle of Man and the Channel Islands—of the position in 1904 with that in 1875.

The acreage of the great crops, were—

	1875.	1904.
Wheat	3,514,088	1,407,618
Barley	2,751,088	2,002,854
Oats	4,176,177	4,351,183
Potatoes	1,431,879	1,200,419
Turnips	2,485,257	1,898,010

The present totals are:—

	Acres.
Arable land..................	18,977,643
Permanent grass	28,693,305
Under crops aud grass	47,670,948

The wheat and barley crops of 1904 were the smallest on record. Some recovery may however be expected in 1905, consequent upon the favourable weather for farming operations in the preceding autumn. It should be again pointed out that figures for isolated years are not conclusive, but simply show the position at these dates. The answer to a question, asked in the House of Commons on the 9th of August, 1904, stated that in 1903 there was a decrease of 2,683,639 acres of land under the plough, and an increase of 3,448,321 acres under permanent pasture as compared with these acreages in 1873. According to the answer to another question at the same date, the approximate percentage of imported wheat in relation to the total supply of the United Kingdom in the five years 1899-1903 was 77½ per cent. It further appears that there is a steady diminution of the population employed in agriculture. The number fell from 1,904,687 in 1851 to 988,350 in 1901 (Blue-book No. 1761, of 1903, p. 362).

The gross assessment on which income-tax was levied in the United Kingdom from the ownership of lands, has fallen between the financial years 1874-5 and 1902-3 from £66,911,453 to £52,162,825 (Inland Revenue Report, 1904, p. 192). In this Return, lands in urban neighbourhoods are reckoned, and values relating to such land have increased. The decrease in the total amount, proves that the depreciation in agricultural districts has been very large. Mr. R. H. Inglis Palgrave, in his paper read before the Royal Statistical Society, on the 21st of February last, estimated that the losses of agriculture in the United Kingdom between the years 1872-77 and 1904, had collectively been about £1,600,000,000—namely, diminution in owners' capital, £1,000,000,000; diminution in farmers' capital, £100,000,000; diminution in farmers' profits, £500,000,000; total, £1,600,000,000. Further, as Dr. Cunningham points out ("The Free Trade Movement," p. 114), "an English farm is a highly complicated product of civilisation, and, if it is disused for a time, or badly used, it deteriorates in every way. The machinery becomes valueless; the buildings go out of repair, and the land itself becomes foul." The English landowners "co-operate actively in the maintenance of farm buildings, and the improvement of the soil." It is further to be observed that income derived from the ownership of land is subject to deductions from which other incomes are exempt. Revenue from land, in addition to income-tax, is subject to charges for the up-keep and maintenance of the property, insurance, tithe, and local expenses, which in the present social conditions a landowner is virtually obliged to defray. If resident on his property, these claims upon the landowner are accentuated; and further, in changing tenants, under new valuations, allowances are granted which are favourable to the tenant to the detriment of the owner. Thus, whereas investments in funds and stocks are liable only to income-tax, the landowners' nominal income is reduced by about one-fourth by reason of the unavoidable deductions above mentioned. The death duties press, in their practical application, more heavily on landed property than on other property. They subtract from the capital of the country, not from income, and, therefore, are a form of taxation which is unsound in principle. In the words of a writer in the *Investors' Review* of October 8, 1904, these receipts of the exchequer have "been sheared off the capital value of the estates assessed. In no sense, therefore, can such moneys be considered revenue." In concluding this survey of the present position of agriculture in the United Kingdom, the case of the farmer and of the labourer must be noticed. The income-tax returns above recorded prove a serious diminution of the capital and profits of owners; and there is reason to believe that in many parts of the kingdom the financial position of a large proportion of the farmers is precarious. In some instances railway arrangements and sales are unfavourable to farming—being regulated to promote traffic from seaports to inland towns, and between large centres of population, rather than to aid the transport of produce from country districts to neighbouring towns.

As regards the labourers, it is to be remembered that in the country, as a general rule, regular full work is not to be obtained throughout the year. Formerly, cottage and miscellaneous industries helped to make up the income of labourer's families. Latterly,

machinery has lessened the number of labourers needed on farms, thatching is discouraged by insurance offices and under new by-laws; ditching, hedging, and weeding are not so cleanly done as in former times, roads are managed from county centres instead of by local action, strangers who rent country houses do not treat villagers with the regard shown for their welfare by landowners who can reside on their property. Recent by-laws apply rigidly to rural tenements regulations framed for town streets, and thus hinder the inprovement and building of cottages. The Duke of Devonshire, in a speech reported in *The Times* of the 6th of December, 1904, said, "Under the existing building by-laws in most parts of the country a cottage for an agricultural labourer could not now be built at a cost of less than £250 or £300, which meant that the rental would be something like £12 or £15 a year." In existing circumstances, an ordinary landlord cannot afford to put up labourers' houses at this cost, nor can an ordinary labourer afford to pay this rental. Steps to promote the construction of suitable cottages at a moderate cost and rental are much to be advocated. Small holdings, and education adapted to country life instead of rigid assimilation to the studies of town schools, are subjects which now receive attention. The Board of Agriculture, by Lord Onslow's personal action, and by the careful and wise methods of the able staff of that department, is doing good work to remedy disabilities with which a government officer can deal. Individual holdings confer a very real interest in the land, and this movement ought to receive encouragment and support. But it does not follow that when a man secures a small holding he will become a farmer and will succeed in his business. Capacity to deal with the business itself is necessary in all cases, and in farming sufficient capital to defray outgoings, and to withstand bad seasons at the beginning of the tenancy, is also necessary. Mr. Eve, K.C., M.P., a landowner and practical farmer, in a speech at Newton Abbot in December, 1904, recognised the fact of agricultural depression, and attributed it to "the exceptional burdens on land, extraordinary competition, and the want of efficient labour." Mr. Eve's opinion, and the facts already stated, hardly bear out the fiscal policy of an eminent member of the House of Commons, put forward in a speech at Southport on the 22nd of January, 1904: "There was lying untaxed a large reservoir from which, he believed, a substantial contribution might be made to fertilise the country at large, and that was the taxation of land." If it is said that this speech was reported in an abbreviated shape, and that land values, and not land, was spoken of, it is sufficient to say here that at a meeting in London on the 20th of January, 1905, Mr. Harold Cox, a leading member of the Cobden Club, who took part in our discussion on the 2nd of December, 1903, moved "that the taxation of land values is unsound in theory and would be disappointing in practice."

The state of things disclosed in this part of the present paper certainly is a national misfortune and is fraught with national dangers. Mr. Lecky, in "Democracy and Liberty," vol. 2, p. 382, pointed out in 1896 "cheap food, it is beginning to be said, does not necessarily mean the very cheapest, and a system under which the greatest and most important of all national industries is almost hopelessly paralysed, under which land is fast falling out of cultivation, and the agricultural population flocking more and more to the congested towns, cannot really be good for the nation."

Our Food Supplies.

Full informaiion on this subject is afforded in the publications of the Board of Agriculture and the Board of Trade. These returns must be studied in order to obtain complete information on the subject. The particulars required for this paper are given in the most convenient shape in Major Craigie's presidential address to the Royal Statistical Society on the 17th of November, 1903. He has done me the favour to bring up the annexed Tables to the end of last year. (See Tables I. and II.)

The percentages of the imports of wheat into the United Kingdom, contributed by different countries, were stated in the following figures in the *Board of Agriculture Journal* for December, 1904. (See Table III., p. 493).

In the answer (published in *The Times* of the 9th of August, 1904) to a Parliamentary question, it is stated approximate percentages of imported wheat in relation to the total supply in the five years, 1899-1903, was 77½ for the United Kingdom, 34 for Germany, and 2 for France. In the case of the meat supply percentages cannot be definitely stated. The subject has been investigated by a committee of the Royal Statistical Society, and there is good reason to think that the average annual supply in the five years, ended May 31, 1903, was approximately in the proportion of 6, home

TABLE I.

A.—Quantity of Dead Meat Imported into the United Kingdom from the undermentioned Countries.

Period.	United States.	Argentina.	Canada.	Australasia.	Holland.	Denmark.	Other Countries.	Total.
1886–1890	254·3	17·1	17·9	37·0	12·4	22·2	23·2	384·1
1891–1895	309·2	31 6	16·2	87·7	21·3	42·2	13·6	521·8
1896–1900	434·5	61 4	34·5	144·9	41·2	63·5	9·3	789·3
1901–1904	418·2	132·3	41·5	123·1	52·6	81·9	11·9	861·5*
1904 (alone) ..	365·4	159·9	54·3	110·4	52·0	98·7	9·4	850·1*

B.—Estimated Quantity of Meat from Live Stock Imported into the United Kingdom from the undermentioned Countries.

Period.	United States.	Argentina.	Canada.	Germany.	Holland.	Denmark.	Other Countries.	Total.
1886–1890	74·6	0·1	27·2	8·4	15·5	19 6	9·4	154·8
1891–1895	119·4	6·0	32·3	—	1·8	2·7	1·4	163·6
1896–1900	131·6	30·8	35·3	—	—	0·9	0·4	199·0
1901–1904	125·7	2·8	42·0	—	—	0·4	—	170·9
1904 (alone) ..	141·2	—	47·3	—	—	0·3	—	188·8

* Including 40,720 tons in 1904 (of which the source is not indicated) allocated to the various countries proportionately to earlier years.

TABLE II.—Quantities of Wheat, Wheatmeal, and Flour Imported into the United Kingdom from the undermentioned Countries :—

C.—*Wheat (Grain) in Thousands of Tons.*

Period.	United States.	Argentina.	Australasia.	Canada.	Chile.	Germany.	India.	Roumania.	Russia.	Turkey.	Other Countries.	Total.
1886–90	1,040·3	58 8	88·7	104·4	59·9	97·9	460·3	97·8	713·7	19·8	53 7	2,795·3
1891–95	1,426·9	384·6	140 6	148·8	97·9	31·5	458·5	40·4	687·7	37·5	37 1	3,485·5
1896–00	1,703·9	397·4	77·1	250 6	40·3	53·7	204·2	76·0	455·2	42·2	32·5	3,333·0
1901–04	1,438·4	599·5	272·3	415·2	17·6	17·4	684·1	93·8	622·3	20·2	27·4	4,208·2
1904 (alone)	354·5	1,072·0	531·5	309·8	45·8	12 6	1,274·2	74·6	1,176 5	21·6	17 6	4,890·7

D.—*Wheat Meal and Flour in Thousands of Tons.*

Period.	United States.	Austria-Hungary.	Canada.	France.	Germany.	Other Countries.	Total.
1886-96	609·1	79 4	46·1	5·1	45·5	15·9	801·1
1891–95	802·2	57·1	70 1	17·4	10·9	9·7	967·4
1896–00	837·0	54·6	91·2	52·4	4·8	15·1	1,055·1
1901–04	738·3	38·0	99·8	41·4	4·4	44·2	966·1
1904 (alone)...............	412·6	36 7	102·3	74·3	13·2	97·0	736·1

products, to 5, importation (*Journal*, Sept., 1904). The largest imports of fresh mutton are from New Zealand, and of beef and bacon from the United States.

TABLE III.

Cereal year, ended Aug. 31.	United States.	Canada.	Russia.	India.	Argentine.	Other Countries.
1895....	42·3	4·3	21·5	7·1	13·2	11·6
1896....	50·2	6·4	18·9	5·0	6·3	13·2
1897....	55·9	6·3	16·6	0·5	1·4	19·3
1898....	63·9	7·4	10·4	8·5	4·2	5·5
1899....	64·5	9·9	3·3	8·8	7·4	6·1
1900....	58·7	9·1	3·0	1·6	19·1	8·5
1901....	64·4	7·9	3·6	1·3	11·1	11·7
1902....	61·7	10·7	3·0	7·3	4·9	12·4
1903....	48·6	12·6	12·3	10·7	10·6	5·2
1904....	25·7	10·4	16·1	19·3	14·6	13·6

It is important also to have before us the

ANNUAL AVERAGE PRICES PER IMPERIAL QUARTER OF BRITISH CORN, 1894-1904.

Year.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.
1894..........	22 10	24 6	17 1
1895..........	23 1	21 11	14 6
1896..........	26 2	22 11	14 9
1897..........	30 2	23 6	16 11
1898..........	34 0	27 2	18 5
1899..........	25 8	25 7	17 0
1900..........	26 11	24 11	17 7
1901..........	26 9	25 2	18 5
1902..........	28 1	25 8	20 2
1903..........	26 9	22 8	17 2
Ten years' average	27 6½	24 5	17 2½
1904..........	28 4	22 4	16 4

REMEDIAL MEASURES.

Mr. Chamberlain, in his speech at Welbeck, on the 4th of August, 1904, reported in *The Times* of the following day, repeated his statement that his proposals are "a sort of sketch plan for the purpose of discussion and consideration." It is important, therefore, to bear in mind that the following rates of duties in the case of agriculture suggested for specified foreign produce are not fixed and rigid proposals:—

1. Two shillings on all kinds of corn except maize.

2. "Such a duty on flour as will result in the whole of the milling of wheat being done in this country."

5. Five per cent. on meat, dairy produce, preserved milk, poultry, eggs, vegetables, and fruit.

To enter fully into these several proposals would exceed the time at our disposal, and would be an investigation which more properly belongs to other societies. Remarks must be limited to main questions affecting the wheat, flour and meat proposals, and some general cautions. Sir James Blyth, in a letter which appeared in *The Times* on the 11th of August, 1903, estimated that "a duty on foreign corn sufficient to raise the price of wheat all round by 5s. the quarter, would be equivalent to one half-penny the quartern loaf." Sir Spencer Walpole, in his "History of 25 Years," vol. 2, p. 432, estimates that the 1s. duty on wheat which remained after the repeal of the Corn Laws, was equivalent to 1/8d. on the price of the 4 lb. loaf." These divergent statements require to be investigated, but are beyond the time at our disposal. Taking, however, general conditions of trade, a statement made by Mr. J. Hill, the president of the American Northern Pacific Railway, and the ablest railway manager in the United States, requires attention in the first place. Speaking to the Minnesota Agricultural Society early in 1904 (*The Miller* of April 4, 1904, p. 85), Mr. Hill said, "a tax of 10 cents. on the 180,000,000 bushels you send to England means 18,000,000 dollars, and you may make up your minds here you have got to pay that 18,000,000 dollars or lose the market. You will pay the tax, or you will hold your wheat, or you will need a new market." According to this opinion, the 2s. duty would be defrayed between the American producer, carrier, or merchant, and the whole North American supply, which Mr. Hill holds is controlled by the Manitoba crop, would be placed on the London market as it is at present. Mr. Boyd Kinnear, writing as a practical Scotch farmer in *The Courier* of January 23rd and 30th, 1904, showed that the Argentine, Roumanian, and Russian wheat growers are, from the circumstances of their trade, dependent upon the London market for the disposal of their stocks. Even if, under the new commercial treaty between Russia and Germany, a large proportion of Russian wheat should

go to Germany, it would seem that the Roumanian supply will still come to England; as well as the Argentine stock, which has no other outlet. This new duty will thus not be likely to affect prices in the United Kingdom. The late 1s. duty on wheat did not raise the cost of bread while it was in force, neither was the price of bread lowered when the duty was taken off.

Lord Brassey, who is a staunch free trader, said at the meeting of the Chambers of Commerce at Montreal in 1903, "I do not suggest that 1s. a quarter on corn, or even 2s. would seriously affect the economic condition in England. The poverty of the poorest comes from other causes than an infinitesimal—and I emphasise the word infinitesimal—addition to the price of bread. A low duty on corn may be balanced by remissions of more burdensome taxation."

Mr. Palgrave, in the paper above quoted, said that a duty of 2s. a quarter on foreign wheat, with free importation of colonial wheat, would "have no effect in raising prices here."

2. As regards the proposed duty on flour, a competent authority in the West of England estimates that 2s. per quarter=5·33 pence per 112 lbs. wheat, and that the equivalent charge on the same weight of flour would be 8·2 pence. The *Mark Lane Express* of the 28th of November, 1904, stated that the Statistical Department of the Customs "reckon 4,800 lbs. of imported (not English) wheat to yield 3,456 lbs. of flour." . . . "Our estimate would have been from 3,552 lbs. to 3,600 lbs." This point would also be a matter for enquiry. As regards the proposal that the duty on corn should be such as to cause the milling of wheat to be wholly done in this country, there is much to be said in favour of encouragement to milling, both in itself, and because an abundance and cheap supply of wheat offals would extend the industry of the manufacture of "compound cake," a most important cattle food. But I entertain doubts whether our present works as now equipped, are capable of doing the entire wheat milling for our markets. As things now stand, it seems possible that this rate of duty on flour would raise the price of bread; and a charge equivalent to 2s. per quarter on wheat would therefore appear to be the preferable plan.

3. The general conditions adverted to are connected with the circumstances of particular trades. Duties might be levied in the case of concentrated businesses—that is to say businesses which are carried on by a limited number of persons, in a limited number of localities and buildings, with much less disturbance of trading relations, and less pressure, than if duties were levied on all agricultural products. Such duties may be logically correct in a scientific tariff. I doubt, hwever, whether farmers attach much importance to them; and public opinion would probably hold that the benefit to be attained would not be commensurate with the inconvenience thereby occasioned. We must beware lest an unfounded allegation of the artificial raising of prices, or plausible misrepresentation on the subject, should provoke popular discontent, render government difficult, and injure the State.

The myth of the big and little loaf is an "object-lesson" in this respect. The thing has not, and cannot have, existence. It is a mere fiction, and yet it is seriously alleged and excites popular feeling. The Bread Act of 1822 and 1836, and the Weights Act of 1878, require bread to be sold by weight. Under these Acts of Parliament, household bread is sold in loaves of uniform weight, and practically therefore of uniform size. There is no big and little loaf, nor can there be. The cry is a survival. The legislation relative to bread, previous to the Acts of 1822 for London, and of 1836 for the country generally, fixed the price of bread. A quarter of flour was reckoned to produce 80 quartern loaves. In practice, however, with the varying price of flour, the size of the loaf varied somewhat; and so in those times there were big and small loaves. This state of things has passed away long ago. This cry has no meaning now; but it is a striking instance of an unfounded argument; and a warning against proceedings which might in a similar manner be misrepresented.

It may be asked how could fiscal changes within the limits above indicated be effected; and what would be the benefit to the landowner, the farmer, and the labourer. The gain to the landowner would be indirect, by means chiefly of the improved conditions which his tenants will obtain. The gain to the farmer would be brought about by more stable and secure market conditions. The gain to the labourer would be the more continuous and regular employment upon which, in these altered circumstances, he could rely. As regards the means whereby these changes might be effected, the first step would be a careful inquiry into these questions, conducted by competent and impartial persons. The aim would be to promote the welfare of the United Kingdom, and to draw closer the rela-

tions between the different portions of the British dominions. The policy of fiscal changes, involving the taxation of food within the limited range of commodities, and at the low rates of duty now suggested, is apt to be misapprehended. The advantages of the scheme in itself, and the accompanying "relief of more burdensome taxation" are apt to be overlooked. As Mr. Balfour said at Manchester on the 11th of January, 1904, "there is no hope of bringing that policy to a successful issue unless you carry with you the conscience, the intellect, and the convictions of the populations concerned."

PREFERENTIAL TREATMENT BETWEEN THE UNITED KINGDOM AND BRITISH POSSESSIONS.

Correspondence published by the India and Colonial Offices (Parliamentary Papers Nos. 1,931 and 2,326 of 1904), affords authentic information on this part of the fiscal question. The report of the India Government is dated Simla, October 22nd, 1903. The state of trade between India and different countries is fully examined. Sir Edward Law, the Financial Adviser of the Government of India, expresses the opinion that it is "more in Indian interests to leave matters as they are, than to embark on a new policy, unless, by its adoption, very great advantages could be obtained by preferential discrimination in favour of our exports to the United Kingdom and British Colonies and Possessions." The position taken by the Government of India is thus summed up: "All that we seek is that we shall not be pledged in advance to accord equal treatment to the imports of all countries alike, irrespective of whether they penalise our exports or not. And we hope that the mere announcement that our hands are free will, of itself, suffice to maintain us in the enjoyment of that considerable measure of free exchange which we already possess, and from time to time even to extend it."

The case as regards the Colonies, stated shortly, is that Canada grants a reduction of 33⅓ per cent. in the amount of Customs duties levied on the products of the United Kingdom; that New Zealand admits specified goods free; and that South Africa admits free goods included in the schedule of 2½ per cent. *ad valorem* duties, and a rebate of 25 per cent. on other duties. The Legislative Council of Victoria has passed a resolution in favour of consulting the other colonies of Australasia relative to a proposed "conference between the Colonial Office and responsible Ministers representing the various colonies." This subject was before the Parliament of the Commonwealth of Australia in the session of 1904, but the debate was not concluded. The House of Assembly of Bermuda has appointed a committee to consider a report on the changes of tariff necessary to admit of a preferential rate on British goods. The House of Assembly and the Legislative Council of Barbadoes, and the Legislative Council of Dominica, have passed resolutions in favour of preferential tariffs. The action taken in Canada, New Zealand, and South Africa is definite and independent action. There is no "offer" in it, or in the expressions of other colonies; but there is "expectation" in Canada, New Zealand, and South Africa, that these grants, which go beyond an "offer," will be reciprocated by the United Kingdom. The Australian and other Legislatures await our decision. It has been stated that the Colonial trade is the expanding branch of the external trade of the United Kingdom. It differs from foreign trade in being under wholly British influences—being under the control of our own, and our Colonial, Governments. The commercial, as well as the social, relations of the different divisions of the Empire are questions of intimate mutual concern. Canada is the leading factor. Sir Wilfred Laurier, speaking on the 12th of October last, said "We have a place in our hearts for British preference, but the feeling is not mutual yet. . . . . The answer is no longer in our hands, but in those of the English people. With good will and a determination to give common ground an understanding can be reached." The *Citizen* newspaper of Ottawa on the 13th of September, 1904, wrote:—"The United States is ready to do business right off. . . . . It is to be hoped that the British people will not linger too long. They have lost half the continent through being too slow to recognise the signs of the times, and they will be in luck if history does not repeat itself." A feeling exists in the United States in favour of a reciprocity league with Canada. There is no active agitation in this direction on either side of the North American border at present; but if this country refuses to enter into closer commercial relations with the Dominion, then the trade interests of the Dominion with the Mother Country and the United States respectively will be transposed. The present home connecting ties will be loosened, and in a few

years an altered position of affairs will exist. There is however, a difference, and possibly several steps, between an abrupt refusal to entertain the question of preferential treatment and the realisation of a practical policy. Various details have to be settled, and certain difficulties must be overcome. Australia is a doubtful element, but would probably fall into line. The instability of parties in Australia, the proceedings in regard to the mail contract, British labour, and the British New Guinea claims, cause doubt to be felt with respect to Australia. The aggressive attitude of foreign governments is likely, however, in some instances, to compel British colonies to decide soon whether they can rely on British support, or whether they will come within the sphere of these foreign interests. In such circumstances a sympathetic attitude on the part of the Mother Country will be of the greatest value. The only alternative to save abrupt refusal of closer commercial union, and in opposition to the preferential policy, that I am aware of, is the scheme sketched by Sir Robert Giffen. In "Economic Inquiries and Studies," vol. 2, p. 399-404, Sir Robert Giffen indicates ways in which "union may be promoted with mutual advantage to all parts of the empire, including the further advantage of accelerating a closer political union."

1. The colonies should adopt a free-trade policy. 2. A postal, telegraph, and communication union, independent of, though not opposing, postal and telegraph agreements with foreign countries. 3. Monetary union as far as practicable. 4. Identical legislation in each part as to the various subjects of commercial law. 5. Common negotiation of all commercial treaties, so that no treaty could be made that did not bind the whole Empire on one side, and did not bind each foreign Government to the whole Empire on the other side.

Points 2, 3, and 4 are matters to be dismissed in a colonial conference. As regards the first point, the economic and social conditions of newly-settled countries preclude the adoption of a free trade policy. In particular ports, such as Hong Kong, Singapore, and Penang, which are *entrepôts* and ports of call, Customs duties may be dispensed with, but in a large district or country no scheme has yet been devised by which the revenue required can be raised wholly by direct taxation. As regards the last point, the negotiation of commercial treaties, the requirements of different parts of the Empire, and the views of their administration are not identical. To bring them all into line is difficult and takes time. Negotiations do not depend on the wishes of one party only—especially when the fiscal policy of one party makes it weak in negotiation. The interests of the United Kingdom, and the attitude of foreign Powers, render long delays in the negotiation of commercial treaties unadvisable. The principle of the present practice is preferable, namely, that the stipulation relative to colonies shall enable them to decide whether they will, or will not, be bound by the treaty; and that special arguments shall be made with foreign Powers to provide for the trade requirements of particular colonies. His Majesty's Government should not engage to grant foreign Powers, either in this country or in any colony, fiscal treatment the same as may be established between different portions of the British Empire. It cannot be too clearly laid down that this subject is no concern of foreign Powers. Differential treatment by such Powers, on the ground that preferential arrangements are adopted in British territories, such as German action towards Canada, requires, for the safety of the Empire, prompt and decisive counteraction.

Lord Avebury, writing in support of our present fiscal system (*Free Trade*, p. 153), says that Canada and New Zealand have made "a substantial difference" in favour of our goods in their Customs tariff, and expresses a hope "that other colonies will follow," and proceeds, "we gladly recognise the spirit in which these advantages are offered, and they will no doubt benefit our commerce." But, as Sir Wilfred Laurier said, the feeling is not yet mutual; corresponding action on the part of the Mother Country is awaited.

It may be asked, what is the estimated gain and result of the system of Colonial preference, supposing it is adopted. The only answer that can now be given is that of the writer in the *Edinburgh Review* of October, 1904, namely, that this gain and result cannot be measured until the nature and extent of Colonial proposals are known. They can only become known by means of a Colonial conference, empowered to discuss the whole subject freely and fully. Mr. Goldwin Smith has well remarked we must not expect to frame a fiscal system equally suitable to the whole number of British communities scattered over the globe, and differing widely in their commercial circumstances. Yet it does not seem to be at all impracticable to arrive at an agreement upon general principles, adapted

to their varying economic conditions. The object in view is a great aim in the welfare of mankind. Mr. Henry Norman, M.P. ("The People and Politics of the Far East," p. 601,), sums up his travels:—"It has been my fortune to see at close quarters almost all the civilised nations of the world, and most of the great colonies, and the result is that I believe in Englishmen above all other men, and in British rule above all other rule. Therefore the British Empire is to me the most important impersonal consideration on earth, and the transmission to our heirs of the legacy of our fathers the greatest responsibility."

Taxation.

Taxation really underlies the fiscal controversy. The point to be determined is the kind and extent of taxation which is most suitable to existing circumstances. Many considerations have to be kept in view in the decision come to; and if the Custom s duties charged, and the commodities on which they are assessed, are so arranged as to yield the maximum of revenue, with the least burden and difficulty in collection, it is truly a revenue tariff. Incidental protective tendencies and effect will thus be due to fiscal exigencies, rather than to a policy exclusively directed to bear upon industry and trade. In this manner, Mr. Gladstone's aim may be accomplished, that benefit is conferred on the working classes chiefly by operating "upon the articles that give the maximum of employment." In proceeding now to submit for consideration the national balance-sheet, the "Statistical Abstract" for 1904, page 1, contains the official statement of revenue and expenditure.

Years ended 31st March.	Revenue.			Expenditure.			Surplus (+) or Deficiency (—).
	Budget Estimate.	Receipts into the Exchequer.	More (+) or less (—) than Estimate.	Budget and Supplementary Estimates.	Issues out of the Exchequer (exclusive of Expenditure not chargeable against Revenue).	More (+) or less (—) than Estimates.	
	£	£	£	£	£	£	£
1889-90	86,150,000	89,304,316	+ 3,154,316	86,723,168	86,083,314	— 639,854	+ 3,221,002
1890-1	87,610,000	89,489,112	+ 1,879,112	88,511,943	87,732,855	— 779,088	+ 1,756,257
1891-2	90,430,000	90,994,786	+ 564,786	90,924,036	89,927,773	— 996,263	+ 1,067,013
1892-3	90,453,000	90,395,377	— 57,623	91,069,560	90,375,365	— 694,195	+ 20,012
1893-4	91,640,000	91,135,410	— 506,590	92,056,068	91,302,846	— 753,222	— 169,436
1894-5	94,175,000	94,683,762	+ 508,762	94,537,685	93,918,421	— 619,264	+ 765,341
1895-6	96,162,000	101,973,829	+ 5,811,829	98,498,496	97,764,357	— 734,139	+ 4,209,472
1896-7	100,480,000	103,949,885	+ 3,469,885	102,324,921	101,476,669	— 848,262	+ 2,473,216
1897-8	103,044,000	106,614,004	+ 3,570,004	104,892,900	102,935,994	— 1,956,906	+ 3,678,010
1898-9	107,110,000	108,336,193	+ 1,226,193	108,815,036	108,150,236	— 664,800	+ 185,957
1899-1900	111,157,000	119,839,905	+ 8,682,905	134,671,823	133,722,407	— 949,416	— 13,882,502
1900-1	127,520,000	130,384,684	+ 2,864,684	184,599,627	183,592,264	— 1,007,363	— 53,207,580
1901-2	142,455,000	142,997,999	+ 542,999	196,843,259	195,522,215	— 1,321,044	— 52,524,216
1902-3	152,185,000	151,551,698	— 633,302	185,429,828	184,483,708	— 946,120	— 32,932,010
1903-4	144,270,000	141,545,579	— 2,724,421	148,442,446	146,961,136	— 1,481,310	— 5,415,657

It is only by means of a conference of authorised representatives of the Colonies that their wants and offers can be known. The words of irresponsible persons, and especially of members of opposition parties, to whomsoever spoken, are of little weight, and are certainly not "evidence" in the question.*

The outlook as regards the revenue in the current financial year 1904-5 indicates a probable surplus, with improved prospects for the ensuing year.

Customs duties in the years 1889-90—1903-4 stand:—

* The above section of the paper does not discuss the objections urged against Colonial preferential treatment on the alleged ground of its unfavourable effects in former years. The reasons for this omission are—(1) that this adverse aspect of the case appears to be overstated; and (2) however this may be, the present circumstances and proposals are so entirely different from the previous condition of affairs that these objections are irrelevant to the suggestions submitted in this paper.

Years ended 31st March.	Coal Exported.	Coffee.	Corn and Grain.	Currants, Raisins, and Dried Fruits.	Spirits, Foreign and Colonial.	Sugar.	Tea.	Tobacco and Snuff.	Wine.	Other Imported Articles	Miscellaneous Receipts.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
1889-90 ...	—	172,832	—	534,831	4,681,225	—	4,490,506	9,061,984	1,302,160	183,157	28,868	20,455,563
1890-1......	—	181,903	—	323,779	4,492,811	—	3,412,258	9,533,888	1,318,006	184,978	31,848	19,479,471
1891-2......	—	177,206	—	346,941	4,427,904	—	3,418,162	9,948,810	1,291,052	188,148	30,086	10,828,309
1892-3......	—	173,858	—	345,464	4,091,524	—	3,399,375	10,124,435	1,268,491	184,786	31,358	19,619,291
1893-4.. ...	—	165,985	—	365,093	4,130,685	—	3,493,094	10,119,952	1,210,142	179,264	34,483	19,698,698
1894-5......	—	170,024	—	396,602	4,197,260	—	3,587,632	10,415,139	1,143,698	197,400	31,193	20,138,948
1895-6......	—	167,673	—	395,186	4 216,921	—	3,746,194	10,748,522	1,254,994	203,297	20,626	20,762,413
1896-7......	—	172,333	—	401,244	4,318,192	—	3,799,372	11,018,048	1,296,181	224,272	36,489	21,266,131
1897-8......	—	170,049	—	389,573	4,299,961	—	3,868,207	11,433,909	1,325,372	267,494	37,685	21,792,250
1898-9......	—	173,590	—	382,005	4,236,160	—	4,023,504	10,993,727	1,399,100	272,540	77,601	21,558,227
1899-1900	—	191,509	—	424,210	4,898,930	—	4,628,946	10,885,922	1,729,540	282,491	1,924	23,043,472
1900-1......	—	189,783	—	349,264	4,769,763	—	6,264,515	12,838,578	1,488,452	331,916	38,688	26,270,959
1901-2......	1 311,706	174,342	—	379,889	4,581,520	6,399,228	5,792,967	10,567,705	1,449,687	346,952	42,873	31,046,869
1902-3......	1,991,767	178,628	2,346,796	416,721	4,739,781	4,478,707	5,975,483	12,451,473	1,523 856	319,156	38,502	34,460,870
1903-4......	2,051,653	188,065	101,234	449,742	4,458,182	5,725 913	6,559,705	12,627,059	1,335,792	363,973	60,004	33,921,322

Other totals in 1889-90 and in 1903-4 were :—Excise, £24,133,232, rising to £31,546,836; stamps, £6,157,154, rising to £7,394,039; Post Office services, £3,524,003, rising to £4,369,067.

A further review of taxation, taken from Sir Robert Giffin's "Financial Retrospect" in the "Journal of the Royal Statistical Society" for March, 1902, a paper which fully explains the course of taxation during the last 40 years, shows the following results. These figures have been brought up to date by Mr. Mackenzie, the librarian of that society, who has afforded me other assistance :—

Decennial periods.	Amounts of taxation: million £. Imposed or increased.	Repealed or reduced.
1861-1871	4 8	26 7
1871-1881	21·0	20·3
1881-1891	12·2	18·8
1891-1901	24·6	5·2
Financial years.		
1901-1902	11·5	—
1902-1903	5·4	—
1903-1904	—	12·8
1904-1905 (estimate)	4·55	—
	83·65	83·80

It thus appears that, notwithstanding the gradual increase of civil expenditure and the recent war charges, Imperial taxation in the period 1861-1904 remains practically unchanged.

The National Debt. funded and unfunded, was in 1861 £823,328,622; in 1901 £762,629,776.

The population of the United Kingdom was in 1861 26,709,456; in 1901 41,458,721.

There has been a large accumulation of capital since 1861—the precise amount cannot be discussed within our limits. Put in another form, Sir Robert Giffen in an article in the *Contemporary Review*, January, 1905, states the case thus :—

Expenditure.

	Forty years ago.	Present time.
Imperial	£70,000,000	£140,000,000
Local	£36,000,000	£144,000,000

Revenue.

Imperial	£70,000,000	£140,000,000
Local	£35,000,000	£105,000,000

The actual burden of imperial taxation cannot, however, be said to have increased during this period, owing to the parallel increase of the national resources. But an unequal proportion of the revenue derived from "taxes" is now contributed by the property and income-tax payers. Exchequer receipts in the year ended March 31st, 1904, were :—

	Millions.	Percentage.
Property and income tax ..	30·8	22
Other sources	110·7	78
	141·5	100

In comparison with taxes, properly so-called :—

	Millions.	Percentage.
Property and income tax ..	30·8	26
Other taxes	88·6	74
	119·4	100

Whereas 40 years ago the percentage to the total receipts was 15 instead of 22.

Accordingly, the income tax is an unduly exclusive charge upon a limited number of the population; and, in its incidence, has become oppressive, at the rates levied in recent years. The incidence of certain other duties and taxes is also above the rates which should properly be levied under normal national conditions. Taxes should be below the rate which will yield the largest revenue properly chargeable in order to permit of ready increase of revenue in case

of need. The burden imposed upon the people in recent years has been in local expenditure, a subject outside the scope of this paper. The national balance-sheet in itself suggests inquiry into our present fiscal policy. There are indications that the revenue is losing in some respects its elasticity and ascending force; and that, at an early date, some readjustment of taxation will be advisable. As regards the future of national requirements and expenditure, we must refer again to Sir Robert Giffen's writings. In a paper on "The Wealth of the Empire and how it should be used" ("Journal of the Royal Statistical Society," September, 1903), he remarks:—

(1.) That the expenditure of 100 millions for internal government, for that is what the figures come to, if we except the Post Office, where the expenditure is largely productive, is not an enormous amount for a community with an income of 1,570 millions, being little more than 6 per cent.

(2.) As regards the military and naval expenditure, "The question of the amount to be spent is for the most part hardly optional. Defences of a certain quality and extent have to be found if the community is not to go under, and the question how much these should cost is really one for experts. Nor does a sum of 70 millions appear overwhelmingly burdensome..... the proportion of 70 millions to the aggregate annual income of the people being about 4 per cent., and to the accumulated wealth .... about 0·47, not a heavy rate of insurance. A comparison of the great military nations—Russia, Germany, and France—also shows that we spend less, and not more, in proportion to means. For these and the like reasons, the conclusion seems unavoidable that there is no real prospect of economy in armaments, and that an increase beyond the present amount is not improbable. .... The nature of our Government tends to cause neglect of these matters. At a given moment we are more likely to be underarmed than overarmed."

The reflection on this expenditure is that the burden is universal, and may possibly bring about some international agreement; but in our case, as matters stand, if our national safety is to be maintained, no large reduction of defensive expenditure can be looked for. Careful and efficient administration may effect economies of limited extent.

(3) Sir Robert Giffen advocates an increase of expenditure on behalf of education in its different branches.

This brief survey respecting Imperial taxation leads to the conclusions that, while it is not unduly burdensome, some readjustment should be considered, and that promises of large reductions are, in Goethe's phrase, an instance of "assertive ignorance," which is one of the most perilous guides in human affairs.

Differential Duties.

In offering some observations on this part of the fiscal question, it is necessary to advert in the first place to a remarkable Parliamentary Return—Differential Duties in the United Kingdom—issued by the Customs in 1904. It is a very complete and well-compiled Parliamentary Paper. It presents a very able statement relative to the Customs system of this country in former years. The impression which this return conveys is, that a system of Customs duties, such as the tariff of the middle of the nineteenth century, would be far too complex, detailed, and extensive to be suitable to the conditions of British trade at the present time. I would add, with deference to the Board of Customs and their very capable staff, that complicated tariffs need technical knowledge on the part of Customs officers. None of the present staff of Customs officers possess personal and practical knowledge of the working of a complex system of duties. While, therefore, suggestions are submitted in principle for a readjustment of Customs duties and preferential treatment in favour of colonial products, it is not expedient on present information, as matters now stand, to enter into details. Sir Charles Dilke, speaking on the 9th of October, 1904, pointed out certain difficulties in the application of differential duties in the existing circumstances of our oversea trade. These difficulties (and also those connected with certificates of origin) must be dealt with in a full and impartial inquiry. It is not intended to advocate measures which would be hurtful or irksome to trade, or which would embarrass Customs' officers.

Exception has been taken to the application of differential duties without, in each instance, previous recourse to Parliament. Executive functions cannot properly be transferred to the Legislature. The executive now possesses power of immediate action in sanitary matters. Similar power existed under the Act 8 & 9 Vict. cap. 90, in Customs matters. This Act authorised the levying by Orders in Council of retaliatory duties against countries which did not allow most favoured nation treatment to the United Kingdom. The reasons why this Act lapsed would be ascertained in the course of a duly authorised and official fiscal inquiry.

Coal and Sugar Duties.

The coal and sugar duties have been subjects of controversy, and it has been alleged that they prove the injurious effects upon trade of the imposition of such duties. The inference alleged is, that these effects are such as to be fatal objections against the policy of fiscal reform, in the sense of readjustment on the lines suggested in this paper. This objection requires to be examined. Putting aside in each case partizan views, the Final Report of the Royal Commission on Coal Supplies, paragraph 130, states that the witnesses who appeared before them "expressed strong opinions against the tax, which they believed was diminishing, and would diminish, the export of coal, and consequently injure their trading power." The Commissioners state their opinion, "Although the figures do not conclusively prove it, we cannot doubt that an export duty must restrict the tonnage exported." Let us now see what "the figures" really tell us. The latest Board of Trade returns give the following quantities of coal, coke, and patent fuel, in tons, exported from the United Kingdom in the years 1092, 1903, and 1904:—1902, 44,897,948; 1903, 46,622,7co; 1904, 48,250,280 tons. The figures "conclusively prove" a growing and not a diminishing trade. There has been a diminution in the quantity of South Wales coal exported to France. The explanation is (1) that the Cardiff trade has obtained better prices in supplying belligerent fleets, and has preferred that course; and (2) that, in the ordinary methods of business, French supplies have latterly been furnished from other quarters.

The Sugar Duty.

The case of the sugar duty in relation to the price of sugar is summed up in the following terms in the "Monthly Record" of the Manchester Chamber of Commerce for November, 1904:—

"In the produce trade the most noteworthy feature has been the great advance in the price of sugar during the past month, which has seriously affected the users of that commodity. This rise has been brought about partly by the restricted field from which British merchants now draw their supplies, owing to the terms of the Sugar Convention; partly to the shortage in the crop of Continental beet, and partly to the tax on sugar imposed to meet the exigencies of the Chancellor of the Exchequer. A movement is on foot, on the part of those interested, to obtain relief, so far as the situation can be ameliorated by legislative action."

The question of sugar bounties has been fully placed before the country from time to time in Papers presented to Parliament. Every administration during the last 40 years has been opposed to them, and, when the opportunity occurred, the endeavour has been made to put an end to them. Every administration has held that the general advantage to British interests which the suppression of these bounties will confer would outweigh the loss which might possibly at first ensue. The circumstances of the case—details are too long to be set forth in this paper—were such that the powers which allowed bounties to be obtained by sugar refiners, would only act towards their suppression by means of an international agreement. The first Convention was signed November 8th, 1864, when Mr. Gladstone was Chancellor of the Exchequer, and Mr. Milner Gibson was President of the Board of Trade. If it is admitted that the general policy of the British Government in this matter was right, it does not follow that every stipulation in each successive Sugar Convention is to be approved. It is to be remembered, however, that if the principle of the suppression of bounties is accepted, the action taken must be adopted by common consent. The foreign powers concerned would not, in the interests of their trade, agree to suppress bounties, if the markets of the countries parties to the Convention remained open to sugars from countries which continued to allow bounties. If suppression was to be effected it must be effected by common action, or not at all. The French economist and freetrader, M. Yves Guyot, an honorary member of the Cobden Club, said with reference to the Convention of March 5th, 1902: "The success of the sugar conference is the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860" ("Journal of the Royal Statistical Society," 1902, p. 440).

Passing from the general statement to the facts of the case, the latest Board of Trade returns give the following statistics of the imports and consumption of sugar, and of the exports of confectionery and aerated waters—trades which allege specific injury from the operation of the Convention of 1902 and the sugar duty:—

Sugar.

	1902.	1903.	1904.
Imports (cwts.)	31,586,909	31,237,399	32,294,442
Home consumption	30,716,364	27,678,442	30,479,985

		Saccharin.	
Imports (oz.)			
	1,045,760	638,753	664,325
Home consumption			
	941,193	483,644	586,178
		Confectionery.	
Exports (cwts.)			
	333,763	319,736	314,780
		Aerated Waters.	
Dozen bottles			
	829,301	869,174	925,098

Approximate estimates given to me by persons acquainted with the confectionery and aerated waters trades are that the sugar used in confectionery is about ¾ refined and ¼ unrefined; and in aerated waters a mixture of refined and saccharin. There are no figures available respecting the home trade in these commodities.

As regards prices of sugars, Mr. Sauerbeck, wrote on January 15, 1904 (*Times* of the 16th):—

The average price of beet sugar in 1903 was 8s. 3d. per cwt., f.o.b., against 6s. 9d. in 1902 and 10s. in the decade 1893-1902; of Java 9s. 9d, per cwt., against 8s. 6d. and 12s. 3d.; of French loaves 11s. 9d. per cwt., f.o.b., against 10s. and 13s. 6d. respectively; at the end of the year beet sugar was worth 8s. 5d. per cwt., f.o.b., against 8s. 2d. in 1902.

And on January 13, 1905 (*Times* of the 14th):—

German beet was worth 8s. 5d. per cwt., f.o.b., at the end of 1903 and less than 8s. in January and February; it gradually rose to 11s. in September, but in consequence of the reduced beet sugar crop in Europe, now estimated to yield a reduction of more than a million tons, great speculation ensued, carrying the price to 14s. 5d. at the end of the year. Java sugar rose from 9s. 6d. per cwt. at the end of 1903 to 15s. 6d., and French loaves from 12s. 9d. per cwt., f.o.b., to 18s. 3d.

Such then are the statistics bearing upon the trades in which sugar is largely used.

Taking in order the points raised in the preceding extract from the Manchester Chamber of Commerce "Record,"—first as to the "restricted field from which British merchants now draw their supplies, owing to the terms of the Sugar Convention." It is to be observed that this restriction is limited to Russia and the Argentine Republic. Statistics for 1904 are not yet available:—

	1902.	1903.
Russia—		
Refined (cwts.) ..	nil	80,049
Unrefined (cwts.)..	6,538	23,245
Argentine Republic—		
Refined (cwts.) ..	6,000	nil
Unrefined (cwts.)..	808,951	418,386

This particular "restriction" is therefore small in relation to the total amount of sugar importation, and it cannot seriously be alleged to affect trade. Next as to the "shortage," this occurrence is to be attributed, as Mr. Sauerbeck says, to the "reduced beet sugar crop in Europe," and arises from climatic conditions. The Sugar Convention of March 5, 1902, took effect on the 1st of September, 1903. Its provisions were well known upwards of a year before it came into operation. The interval was too short to allow of a large increase of cane sugar under the security against hostile bounties which the Convention affords. The Board of Trade returns show an increase in cane imports, and to this extent the Convention has been beneficial and not injurious to the various branches of the sugar trade. To allege that the Convention had anything to do with the summer weather of 1904 and its consequences would be a "Tenderden steeple" argument. Lastly, as regards the effect on prices of the sugar tax imposed by the Budget of 1901, Mr. Sauerbeck's figures show that the lowest prices ruled in 1902. According to the Board of Trade returns, the average cost per pound in London was—1899, 1·5d.; 1900, 1·5d.; 1901, 2·0d.; 1902, 1·5d.; 1903, 2·0d.; 1904, 2·25d. These prices, the fluctuations in previous years shown by the Board of Trade chart and the information given by Mr. Sauerbeck, indicate that the recent variations in the price of sugar are to be attributed to natural causes. Sugar refining in this country is now a reviving business. Sugar cultivation, as shown in the Society's *Journal* of the 17th of February, p. 347, is being developed in tropical and sub-tropical countries; and the prices quoted for this year's beet sugar are already lowering, and indicate the expectation of an adequate European supply this year. *The Times* comment on the deputation to the Chancellor of the Exchequer on the 13th of January, 1905, is borne out by the subsequent course of trade, that seldom has a weaker case for the abolition or a tax been presented to the Treasury.*

The Question before the Country.

Certain cautions should now be adverted to:

1. Free trade is not an application of new principles first propounded in the nineteenth

* The above section was written previous to the debate in the House of Commons on the 27th and 28th of February. The only remark necessary to make on this debate is that it strengthens the argument for the need of a two-fold supply—cane as well as beet—and accordingly justifies the Convention of March 5, 1902.

century. The industrial history of England proves that public opinion and policy in fiscal matters has varied. The respective systems of Free Trade and Protection, or, as Dr. Cunningham styles them, Plenty and Power, have alternatively been adopted and changed. The last Protectionist phase was of long continuance; it began when England became a colonial and mercantile State; it was rigidly applied to navigation under the Commonwealth; and it was extended to land in the reign of George III.

2. Professor Marshall, in "Principles of Economics," vol. 1, page 90, writes: "An economic law is applicable only to a very narrow range of circumstances which happen to exist together at one particular place and time, but quickly pass away. When they are gone, the law, though still true as an abstract proposition, has no longer any practical bearing . . . . every age and every country has its own problems, and every change in social conditions is likely to require a new development of economic doctrines."

3. Professor Ashley, in the preface to "Economic History," observes that, economic theories are based consciously or unconsciously on conditions present when these theories become prevalent.

4. Other factors, therefore, besides direct economic conclusions, require to be taken into account in questions which enter into practical politics.

5. It is to be borne in mind, as was shown in the paper of December 2nd, 1903, that the repeal of the Corn Laws did not, in itself, lower the price of bread—that wheat did not fall, permanently, below 40s. per quarter until 1884, and was cheapened by other causes.

6. It is also to be borne in mind that the fiscal legislation of the forties did not lead, in itself, to an extension, either of our own foreign or of international trade. Mr. Cobden recognised this fact, and changing his course of action induced, in 1860, the Governments of Great Britain and France, to adopt the policy of tariff commercial treaties, which accomplished the object in view. According to a statement made by his personal friend, Mr. Henry Blackburn (*The Times* of March 28th, 1904), if treaties failed Mr. Cobden advised retaliation.

7. The classification of goods, and the precise rates of duties, to be proposed, are details on which the Customs would advise. The aim in view is not to increase the cost of living or of manufactures.

8. We must beware lest any expression of opinion based on economic, industrial, or scientific grounds should be, or appear to be, governed by party consideration. Without undervaluing convictions, or the truths which they affirm, the spirit of our investigation should be an earnest desire to look at facts thoroughly and sincerely—having done so—then to adopt the conclusions to which they truthfully lead.

9. The fiscal question comprises various and complex subdivisions. The last words in the controversy may not be wholly and entirely on one side in the controversy. Some details are likely to prove to be instances in which there will be five points in favour of one, and four points in favour of another solution.

Mr. Balfour stated the question which he puts before the country in these words, on the 26th of January, 1905:—

"First, I desire such an alteration of our fiscal system as will give us a freedom of action impossible while we hold ourselves bound by the maxim that no taxation should be imposed except for revenue. I desire this freedom in the main for three reasons. It will strengthen our hands in any negotiations by which we may hope to lower foreign hostile tariffs. It may enable us to protect the fiscal independence of those Colonies which desire to give us preferential treatment. It may be useful where we wish to check the importation of those foreign goods which, because they are bounty fed or tariff protected abroad, are sold below cost price here. Such importations are ultimately as injurious to the consumer as they are immediately ruinous to the producer. Secondly, I desire closer commercial union with the Colonies, and I do so because I desire closer union in all its best modes, and because this particular mode is intrinsically of great importance, and has received much Colonial support. I also think it might produce great and growing commercial advantages, both to the Colonies and the Mother Country, by promoting freer trade between them. No doubt such commercial union is beset with many difficulties. Those can best be dealt with by a Colonial conference, provided its objects are permitted to be discussed unhampered by limiting instructions. Thirdly, I recommend, therefore, that the subject shall be referred to a conference on those terms. Fourth, and last, I do not desire to raise home prices for the purpose of aiding home productions."

Mr. Chamberlain, summing up on the 1st of February his previous utterances, stated the question before the country to be first, a problem of Empire; and, secondly, a problem of employment for the people. The first task and duty is "to unite varying races, varying interests, and different aspirations," and to make

them "an organised whole." The position is only just beginning to be understood and appreciated. "It is a great potentiality, the greatest that has ever been given to man; but, for the moment, it is a loose bundle of sticks, bound together indeed by a thin tie of sentiment and sympathy, but a tie, after all, so slender that a rough blow might shatter it and dissolve it into its constituent elements." The problem of the social condition of the people—of employment—depends upon recognition of the facts of the case in relation to the present economic and industrial position of affairs in the world, and the policy in these matters of competing countries. Mr. Chamberlain has described his proposals as a sketch or outline for consideration and discussion; stated briefly, new duties of moderate amount on agricultural produce, and a 10 per cent. tax on foreign manufactures. This scheme is being worked out by the Tariff Commission, of which Sir Robert Herbert is chairman; their object is stated in a letter which Mr. Hewins, the secretary, addressed to me, forwarding papers for the Exeter Chamber of Commerce, "to obtain the exact facts of the business situation and not mere opinions for or against any fixed proposition." Until the recommendations of this body are before the public we cannot say anything as to the results of their labours; yet from their papers, relative to the iron and steel trades, it would seem that the enquiry is conducted from the standpoint of English manufactures, and may constitute a "case" from this point of view. At all events, it is very useful, in the interests of free discussion, to learn the proposals of persons, who wish for any particular changes, stated in their own words. Opinions in support of the opposite policy have been expressed by (1) Sir Henry Campbell-Bannerman, on the 17th of November, 1904: "They had, from the first, guarded against being represented as holding that free trade was, in itself, any sufficient and final security for the nation's well-being, or that they were disposed to rest satisfied with many of the conditions which prevailed in this country." (2) Mr. Herbert Gladstone said, on the 6th of December: "The conditions of modern industry were very different from what they used to be. There were now vast joint stock companies, and the sense of individual responsibility was consequently lessened. The result was that when there was a wave of slack trade, men were discharged in tens of thousands throughout the country." (3) Mr. Asquith, on the 13th of December, asked people "not to blind themselves to the real dangers which beset our trade and imperilled our national prosperity. The over-sea trade was not an exhaustive or altogether reliable criterion of the resources of the country. There were symptoms of stagnation which called for thought." These opinions were expressed in support of an alternative policy, namely, various means intended to alleviate existing burdens and conditions combined with the maintenance of the present fiscal system. This alleviation, it is urged, may be obtained by means of a reduction of national expenditure, by recourse to improved trade methods, by the adoption of better education, by new provisions relative to small agricultural holdings and forestry, and by extending employment. These alternatives have been put forward somewhat vaguely without indication of the precise enactments in view. Certain measures of this nature would be useful as far as their influences could extend. The question of reduction of expenditure has been dealt with already. It is imperatively necessary not to imperil the national safety or to endanger our colonies. The security of the British and other white populations in the West Indies and other localities far outweighs the small savings to be effected by the withdrawal of garrisons, which savings would be more than lost in insurrections or wars. Several of the suggestions mentioned are fragmentary rather than comprehensive. They do not cover the ground, and in some instances would involve increased expenditure. The controversy has been obscured by certain positive statements: (1) That food must not be taxed—whereas, in present practice, it is proved that a large revenue is derived from Customs duties on food. In principle, therefore, a proposal (for instance) to place a low duty on wheat, and to reduce the duty on tea or sugar, is in harmony and not at variance with our existing fiscal system. (2) It is alleged that if "you begin with 2s. you will follow the experience of other countries, and there will be no stay until the duty is grinding and substantial." The conditions of the population of the United Kingdom, France, Germany, the United States, and other countries (which the Board of Trade designate "protected") are widely different. Our distribution of population, as shown in the beginning of this paper, precludes a system of rigid protection. But there is nothing in economic science to prevent a re-adjustment of the details of the fiscal sys-

tem adopted in 1846 and 1860. Previous free trade systems have been varied. It is further to be remembered that Customs duties are fixed by resolutions passed by the House of Commons, which will not be passed, or at all events cannot be long acted upon against the will of the country: taxes are not altered or raised merely in consequence of having been once imposed. (3) "Retaliation never succeeds, and is injurious to the power which resorts to it." Instances are cited in the paper of December 2nd, 1903, and others might also be adduced in British experience, which prove that these two assertions are incorrect. As the same time, it is admitted that the first result of resistance to an assailant may be a harder blow—but there is a duty and necessity of self-defence. (4) Sir Edward Grey said on the 6th of January, 1904, if our customs tariff is settled by political pressure, "never again should we have the same purity about politics as we have to-day. It would become a matter of log-rolling between different trades." This warning is correct. The suggestion offered on the 2nd of December, 1903, and now repeated, is that our tariff shall be fairly short, simple, fair, and remunerative. The course of action suggested would, it is believed, prevent the evils indicated.

In conclusion—to sum up—it is hoped that the preceding pages, in addition to the previous paper of December 2nd, 1903, have explained the industrial and economic state of this country; the attitude and policy of foreign Powers; the position as regards India, and the Colonies; the proposals before the country; and the alternatives and objections to these proposals. It is hoped, too, that nothing has been said to increase partisan feeling. The endeavour has been to submit a statement which will complete the former paper and present the fiscal question in its more recent aspects. It is a subject of real importance to each person in the country individually. The Association of Chambers of Commerce adopted on the 9th of March, 1904, the following resolution:—"That the United Kingdom has just cause of complaint of certain restrictions and unfair arrangements directed against the commerce of the Empire, and that the Chambers of Commerce would support His Majesty's Government in measures of negotiation, and urge the Government to appoint a Royal Commission to investigate and report upon the whole fiscal policy of the nation."

At their meeting on the 1st of March, 1905, the Chambers dropped the recommendation in favour of a Royal Commission. By a vote of 42 to 21—39 Chambers not voting either way—direct action against unfair competition, to effect a lowering of hostile tariffs, for promoting Imperial trade, and in favour of a Colonial conference, was asked for. Lord Goschen and Lord Brassey support the proposal for the appointment of a Royal Commission. The Duke of Devonshire's secretary wrote to a correspondent that "The Duke has never objected to any enquiry into the fiscal question, but he is not sure that a Royal Commission would be the best means."

It is thus shown that there is a general admission that the present economic and fiscal system of the country is not satisfactory. Is it not the case, when firm ground in the discussion is reached, that differences on this point have been somewhat overstated? Ideas remain in men's minds, and influence their expressions of opinion, after these ideas cease to correspond with facts. While words remain the same, the technical terms and sense attached to them vary in course of time. As Dr. Jowett said, we cannot really understand "propositions if we are unable to 'reword' them. We do not know ourselves, nor can anyone else know, whether we have pierced beneath the environment of language which encloses them to the truth beneath."

This reasoning fits in with much of the use of the terms "Free Trade" and "Protection." We need to know the exact meaning now attached to words, to get at facts, and to ascertain present requirements. The course of action to which this paper leads is a free and full investigation of the fiscal question, impartially conducted, in its home and colonial aspects. The administration in office alone can give this enquiry an authorised and competent shape; they alone can properly determine its designation, constitution, nature, and scope, and supply the materials needful for the investigation. Next, as regards the tariff part of the question, the Netherlands tariff is an instance of a tariff comprising a large number of items charged with low revenue duties. The working of a tariff of this nature should be considered in its possible illustration of the working of a similar tariff in the United Kingdom; a shorter tariff would probably suit us better. Then as regards the difficulty and delay in such an investigation, when the administration of 1868 accepted the policy of the addition of compensatory duties to the rates of French import duties fixed by the Treaty of 1860, I was

appointed to act jointly with a French commissioner in adjusting these sums. The task was accomplished in six weeks, to the satisfaction alike of the Free Trade administration in London, and of the Protectionist government in Paris. This fact shows that there would be no real difficulty in considering the readjustment of our Customs duties, without endangering any interests, and without resort to extreme measures, in order to fulfil the altered circumstances of our times. The main objects would be to afford relief to home industries; to benefit our working population; to extend trade relations with the Colonies; and to counteract hostile foreign tariffs. To what result this enquiry may lead, and how far a readjustment of tariffs may be found practicable, must be, until the enquiry is well advanced, open questions. All that can properly be claimed now is that this enquiry is necessary; and that it ought to be full and free. This claim is surely not at variance with principles of progress; those who advocate enquiry and a Colonial conference are really progressives. Lastly, the fiscal question, as now placed before the country, is not likely to be dropped; nor is it likely to be settled, except by a solution which will be upheld by a large preponderance of public opinion. Our functions are restricted to considerations based on general economic grounds. We cannot properly discuss details of particular schemes, or tentative suggestions, which may not be borne out in an authorised and free enquiry. The Society of Arts has helped forward many movements of public utility. If we can now, in some measure, aid public opinion towards the settlement of questions of deep importance to our home industries and commerce, as well as to Indian and colonial interests, we shall be following our predecessors in fulfilling the objects of our Institution.

DISCUSSION.

The CHAIRMAN called attention to the fact that in order to allow good time for debate, Sir Charles Kennedy had omitted many valuable portions of his paper, but on reading it fully in the *Journal*, he was sure that all would agree that it was a masterly exposition of the facts and conditions of the fiscal system as it stood at present. The concluding paragraph of the contribution gave the keynote of the spirit which should actuate those who intended participating in the discussion. Sir Charles's desire had been to aid public opinion in arriving at a conclusion on an admittedly difficult question, and one which was fraught with vast importance to the weal or woe of our country and our Empire; and at the same time Sir Charles disclaimed any party or partisan spirit. That calm judicial spirit seemed unfortunately to have been lacking so far in the study of the subject, as presented by public men, and often in the contributions to the public journals. It was very unfortunate that the subject had been relegated to the arena of party strife, because one result had been the use of arguments which were more ingenious than honest, and an exaggerated importance was given to unimportant details. The very difficulty of the subject should be a fascination for the student to get at the bottom of it. In illustration of his contention, very little consideration had been given to the effect which a change in fiscal policy would have on the banking and shipping of the country—two most important interests. As a colonial he could assure his hearers that the colonists would not approach the subject in any selfish spirit. Many people in England thought the recent scheme originated in the Colonies, and that the Colonies were seeking to obtain the best of the bargain; but, if he knew anything of the Colonies, he could give the assurance that that was very far from the animating idea. The Colonies were prepared to make as great sacrifices as they expected the people in this country to make. The idea that Canada and Australia would expect a measure which would result in dearer food for British people was ridiculous, for it was with the working classes of England, from which the colonists mainly sprang, that their chief sympathy rested. Moreover, some of the colonies, without receiving anything in return, had already given substantial benefits to British trade, and others would fall into line as soon as the scheme was matured. It was obvious we could not seek, under the present system, to expand our home trade, because it was everybody's trade, and we could not expect to expand our foreign trade, because we were shut out of the markets, so that the only field possible for the expansion of British trade was the Colonies. True, the volume of colonial trade at present was not equal to the foreign, but the latter was a decreasing quantity while the latter was increasing.

Major CRAIGIE thanked his old friend the author for his able paper, and for enabling so many difficult subjects to be discussed on the common ground of ascertained facts and figures, which was the only sure and definite method of arriving at a conclusion on the subject. He specially referred to the diagrams exhibited, setting forth the proportions of the population engaged in various occupations, and the wider fact as to how the population of the Empire was made up. It would have been interesting if the analysis could have been extended to the Colonies and to our Indian possessions. It was of great interest to see that the occupation which bulked the largest was that of agriculture, and that

the next largest was the class engaged in domestic service. Other important Tables were those giving the taxation and imports into this country and the extraordinary changes, over a series of years, in the sources of those material imports—such as the meat and the wheat supplies, particularly the increases from Argentina and India, and from Australasia.

Dr. BENEDICT GINSBURG said all must feel grateful to Sir Charles for his able paper, which was remarkably free from party politics, and marshalled facts and figures with singular lucidity. On the question of taxation, Sir Charles had shown that one-third of the population of our country was unoccupied, which seemed to show that everything was not for the best in this country, and that our system had not helped us forward in the way one might desire, considering the extraordinary position occupied by England and her wealth of mineral industries. With regard to Imperial taxation, Lord Selborne spoke in the House of Lords the previous evening on the cost of national defence, remarking that if it were not for the strength of the British navy it would be impossible for our present fiscal system to continue. That could be put in another way. When we were getting the cheap loaf we were paying a certain amount for the loaf in cash, but we were also paying something in the taxation which went to keep up the defence of the country, and the apparent cost was not the real cost. It was strange that so many people who argued against the possible taxation of food were those who suggested we were spending too much money on the necessary defence of the country. Money had also to be found for local taxation, which was growing rapidly. The burdens which had to come out of an industry in any way were a tax upon the industry whatever they were called, and to whatever they were applied. The manufacturer who had to pay a certain sum of money in rates had his business as much burdened as if he were paying an equal sum on the raw material which he worked up. It was considered unfair that he should pay on the raw material, but it was not considered unfair that he should be burdened with rates to provide baths and wash-houses for people whom he did not want to see washed.

Mr. ARMYTAGE BAKEWELL recalled Lord Salisbury's remark that our great difficulty with regard to the tariffs of other countries was that we had nothing to give in exchange; we had no power of retaliation; we could not say, "If you take off your duties on such and such goods we will allow your goods to come in on easier terms." A former leader of the Anti-Corn Law League had told him he was firmly convinced that a change of policy was now necessary. We never had free trade, for we taxed things we did not produce, and did not tax things which we could produce. The result was we were preventing our people having the home market they ought to have. It was strange that a statistician did not point out, in dealing with the preponderance of agriculturists and domestic servants, that one was a productive and the other a non-productive class. Mr. Cobden himself repeatedly emphasised the fact, and he advocated free trade on the assumption that other nations, seeing its immense benefit, would soon fall into line. But those people had been wiser than we had. The question had been put before the audience in the ablest possible manner that evening because it had been dealt with entirely outside party. We were helping to pay Germany's taxes, and we required a system whereby Germany should help to pay ours. It was a great pity the question was put on one side in the House of Commons by those who seemed afraid to call their souls their own. Our leaders must lead the people, and not simply ask them what they wanted.

Mr. W. BOUSFIELD wished to refer to the statemen by the author that this had become, to a large extent, a residential country: that those who resided in it and were not classed under any special head formed a very large part of the population. There were many advantages in that, and indeed it was necessary for the central city of a widespread Empire. Free trade had made England one of the best places to reside in in the world, and one did not now find large numbers of English people residing abroad for the sake of cheapness of living. The same cheapness largely affected the working classes, who had to carry with them a large number of ineffectives——widows, young children, those who were aged. The working classes had shown a perfectly sound instinct in the matter; they had seen that to put taxes upon food and upon various manufactures must increase the expenses of their daily life. What was called the unoccupied class, was the product of the wealth of the country during centuries, but it had rapidly increased in the last forty years, and it was difficult to believe that the fiscal policy during that time had had much to do with it.

Mr. G. BYNG, speaking as a producer, who was born abroad, but had lived in this country 25 years, referred to "dumping," which had been defined as selling goods in a country under the market value. But he thought dumping could not be defined, and that an erroneous impression about dumping was at the root of the differences existing between those who advocated protection and those who held to free trade. It was agreed that dumping killed industries and killed the producer. But the free-trader said that for that disadvantage we got cheapness. He spoke from experience when he said that foreigners were not sending their goods into our country for nothing, even under cost price; but they were paying

dearly for it. The advantage of free trade and of cheapness were non-existent, and the idea that the English working classes lived cheaper than those on the Continent was wrong.

Mr. G. G. CHISHOLM, while thanking the author heartily for his able paper, said it must be conceded that the subject was very difficult and complex. Geographical circumstances might be of great importance in the arguments raised on the question, and he instanced the case quoted in the paper regarding the farmers in Minnesota. He admitted that the Minnesota and Dakota farmers would have to accept a smaller price than the farmers of Manitoba, but it did not follow that the prices in the North-West Territories would not be higher than they otherwise would be in consequence of the duty. In Canada there was a natural tendency to the expansion of wheat fields, and that had been accompanied by a very great migration from the United States into Canada. Granting a preference to Canada would go far to stimulate a transference of the population from the wheat-growing areas of the United States to Canada. But the United States had rapidly become much more of a manufacturing country, so that the amount of wheat it could spare for export had been recently a diminishing quantity, and there had been a tendency for immigration into the United States to be a steady stream. In conclusion, he referred to the great variation of the sources of supply of wheat, from Argentina, India, and Australia, and pointed out the importance of depending on a world-wide supply, and not doing anything to restrict our source of supply to one or two parts of the world.

Mr. NATHANIEL COHEN supported the general tenour of the plea in the admirable paper of Sir Charles Kennedy, because it agreed with the proposal which he supported at the Congress at Montreal nearly 18 months ago on behalf of the Chambers of Commerce and which was carried unanimously. But he did not agree with the plea for further discussion in the present House of Commons, for the continual recital of opinions from familiar speakers in that assembly did not seem to forward the question at all, and there seemed a tendency to avoid points which were the very crux of the matter. Mr. Bousfield had mentioned the great importance of not raising the cost of living, with the view to retaining the residential amenities of this island, but that gentleman ignored the very keynote of those who came forward to urge the greater development of our Colonies, viz., that under the existing conditions we were within measurable distance of finding the cost of food rising from natural causes. Fully 90 per cent. of the most fertile lands of Canada had not yet been brought under cultivation. People seemed absolutely indifferent to the notable fiscal advantages which had been granted to us by our nearest colonies, and at Montreal it was mentioned that since that rebate the cash value accorded to British trade and manufactures amounted already to £2,600,000, and by now the figure would probably be £3,500,000. It was unsatisfactory that we should receive that contribution and not be willing to enquire fully whether, without substantially raising the cost of living, we could not reciprocate in some way acceptable to the Colonies. Discussion had been pleaded for on the basis of facts and figures, but he also asked that human experience should be regarded; it was not sufficient to ask abjectly for something; we should be able to urge the requirements by something tangible. The subject having been allowed to drift on to party lines, with the consequent acerbation of the discussions on it, it was difficult to find men free from partisan political affinities.

A hearty vote of thanks was accorded to the author, on the motion of the CHAIRMAN.

Sir CHARLES KENNEDY, in reply, thanked his audience, and more particularly the speakers, for the kind reception given to his paper. The points which had been made by the speakers would add much to the value of the record in the *Journal*. He had dealt slightly with the question of local taxation, but full information is contained in the writings of Sir Robert Giffen quoted in the paper. A section on employment had been sketched in the first instance, but, in view of the able analysis of the last Board of Trade Blue-book, to be found in the Society's *Journal* of the 24th of February last, it seemed unnecessary to compile another version of the subject.

THE REGISTRAR-GENERAL'S ANNUAL REPORT.

The Report of the Registrar-General of Births, Deaths, and Marriages in England and Wales, issued recently, shows that the fall in the birth-rate has not been checked. The method of measuring the birth-rate by calculating the proportion of births per 1,000 women of conceptive age (15-45 years), as an alternative to calculating the proportion of the total population, is for the first time adopted in this report. It is believed by the Registrar-General to be a preferable method by which to measure the birth-rate. Unfortunately, it discloses even a greater fall than has hitherto been shown. The proportion of total births per 1,000 women, aged 15-45 years, taking three-year periods, is as below:—

1870-2.	1880-2.	1890-2.	1900-2.	1903.
153·7.	147·7.	129·7.	114·8.	113·8.

The proportion of legitimate births per 1,000 married women, aged 15-45 years, fell from 292·5 in 1870-2,

to 233·3 in 1903, and of illegitimates in the same period from 17·0 to 8·4. The deaths registered in England and Wales during 1903 were in the proportion of 15·4 per 1,000 persons, being the lowest rate hitherto attained, the next lowest being 16·2 in 1902.

The decrease in the marriage rate continues. The subjoined Table shows the annual marriage rates of both bachelors and widowers, and both spinsters and widows, calculated on those sections of the population aged 15 years and upwards :—

	Bachelors.	Widowers.	Spinsters.	Widows.
1880–82	55·7	58·2	56·9	18·2
1890–92	54·8	53·4	54·5	16·3
1900–02	54·7	44·4	53·0	14·4
1903	54·0	40·6	52·2	13·4

It will be seen that the decrease in the marriage rate is general, but it is considerably greater among widowers and widows than among the unmarried of either sex.

It is good to observe the steady fall in the mortality of pulmonary tubercolosis. It continued throughout the period covered by the present report, the loss of life from this dread disease being now only three-fourths of what it was twenty-five years ago. Unfortunately similar comfort is not to be derived from the cancer statistics. The deaths referred to cancer, or malignant disease, amounted to 29,089, exceeding by 2,795 the average number in the previous ten years corrected for increase of population. Among males the corrected numbers were in excess by 15 per cent., and among females by 7 per cent. If the deaths from malignant disease be calculated on the aggregate population the disease appears to have exacted a death total at all ages of 732 per million among males and of 1,003 per million among females. Both these rates are the highest on record. The following figures give the rates of mortality from cancer per million living at each of five groups above the 35th year, the "average" being the average rates in the five years immediately preceding 1903:—

	Average.	1903.
35	·650	·671
45	1·920	2·039
55	3·987	4·164
65	6·287	6·626
75 and upwards	7·077	7·571

Compared with the average in the previous five years the increase of cancer mortality in 1903 was greatest at the higher ages. Other figures show that in both sexes the increase appears to have been greatest in the urban counties.

In 1853, 304 out of every 1,000 men, and 439 out of every 1,000 women who married signed the marriage register by mark. In 1903, only 19 out of 1,000 bridegrooms and 23 out of 1,000 brides failed to sign their names. In the year under notice, of the total number of illiterates 55 per cent. were women and 45 per cent. men. In London, which is exceptional, the number of husbands who signed the marriage register by mark averaged 22, and the number of wives averaged 31 per 1,000 marriages. But illiteracy is practically confined to a group of five registration districts—London City, Bethnal-green, Whitechapel, St. George-in-the-East, and Mile-end Old Town. Excluding these districts the proportions of illiteracy in London will be reduced to nine signatures by mark of husbands and 12 of wives in every 1,000 marriages. In the following Table, the five districts are compared with the remainder of London — :

Registration district.	Signature by mark, per 1,000 marriages, 1903.		Jewish marriage per 1,000 marriages 1903.	Natives of Russia, Helgium, Poland, Servia, Roumania and Bulgaria per 1,000 of the population in 1901.
	Husbands	Wives		
London City	89	85	359	13·3
Bethnal-green	37	63	—	27·3
Whitechapel	164	240	461	265·1
St. George-in-the-East	37	123	115	241·0
Mile-end Old Town	251	241	482	89·4
The above five districts	150	210	320	117·4
The remainder of London	9	12	4	2·2

Nearly all the signatures by mark in London City, and in Mile-end Old Town, occurred in marriages of foreign Jews. The apparent discrepancy between the large proportion of Jewish marriages in Mile-end Old Town, and the comparatively small population of foreigners resident in the district, is due to the fact that many of the marriages are those of Jews resident in St. George-in-the-East, Whitechapel, Bethnal-green, and other districts.

CORRESPONDENCE.

METHODS OF DESIGN EMPLOYED IN MOHAMMEDAN ART.

In the brief interval between the reading of Mr. Hankin's paper on Wednesday last and the report of it in our *Journal* of this evening [the 17th March] I forgot to add many of my remarks on his brilliant paper to the "proof" received by me; and I would like to make good some of these omissions in the present memorandum. In expressing my personal opinion that Mr. Hankin pushed his ingenious theory too far, I stated that, while in India, I had employed all classes of craftsmen, under my own eyes, and that on whatever work I employed them, they never used any kind of design whatever. The "designs" in jeweller's books were mere advertisements for the attraction of Europeans, were never worked from. It was fatal to success to tell Indian craftsmen to work from a previous master-

piece of their own, if you told them to reproduce it exactly; for in duplicating it with mechanical exactitude they destroyed all its artistry,—the beauty, and the life the artist's thought and sleight had given to it. The only way to possess yourself of your desire was to say:—"May God help you to devise another thing of beauty ["sparkling," "dancing," or "prancing" thing] like this you did for me before, of the same weight and size, and equally alive and exquisite ["sparkling" &c. over again], and equally to my delight and your honour: *and you know I shall not haggle over the price.*" Then you get all you desire, *and better.* It was always in that way I consulted and dealt with these craftsmen. I would never accept trash, and, without any bargaining, I always paid in cash; and for myself and friends I always secured the best "Sidonia wares" of my day in Bombay. Never haggle about prices and you will always get the best value for money in India, as well as everywhere else in the world. The ivory and wood carvers would execute the most intricate "Arabesque" designs in wood and ivory, not only without a trace of geometrical, or even mechanical planning, but seated on the floor, crumpled up on their haunches, and using their knees as the only support of the strip of ivory or wood they held with the left hand, and worked with the right. They would work on like that all day, with no more thought of the geometry, or the anatomy of ornament, than have the bees in moulding their wonderful hexagonal cells by the rotation of their little heads. All the time I was in India I never saw a "template" or a stencil of any kind used; and I said at Mr. Hankin's lecture that I was sure he had not; and he at once acknowledged that he had not. I was observant also of a great deal of house building in Bombay, nearly all of European design and under European superintendence. The only exception was a little mosque in the north-east quarter of the Island, near the sea shore, under Chinchpoogly Hill. It was built by a small body of stonemasons; and from first to last not only without a draughted plan, but without measurements. I have often cited the case in opposition to my distinguished friend Sir Caspar Purdon-Clarke's contention that no one could build a house without a plan. I was *officiously* with these masons daily; and only occasionally would they have an aside consultation over some hitch in the construction, or some point of decoration,—which was nearly all in the proportion of the construction,—and then they would trace out their casual "plannings" in the dust on the ground, and with their forefingers, or I would help them with my walking-stick. I do not know how it is done—by instinct, by rote, or by divine inspiration (*i.e.*, genius). I only know that the thought of "Glory to God" works wonders by the hands of these men, Hindus and Muslims, and that honest payment, as God's blessing on their work, fills them with devout gratitude, and enthusiastic gratification in it.

GEORGE BIRDWOOD.

GENERAL NOTES.

BASUTOLAND.—The Basutoland census shows a rather startling increase in numbers. Comparing 1891 with 1904, the population has increased from 218,324 to 347,731, or close upon 60 per cent., the increase in females being over 64 per cent. Notwithstanding the efforts made by the Chief Lerothodi to collect the money necessary for an industrial school —he has collected £4,564, and a director has been appointed, plans drawn up, and the buildings commenced—the daily average number of scholars in the schools is only 10,401. The Resident Commissioner, in his report just published (Cd. 2238), says that the increasing desire for some form of education exhibited by a section of the people is by no means universally felt. The bulk of the young people are growing up without education as it is understood in Europe. "But it would be an error," says Mr. Sloley, "to describe as ignorance the condition of the natives who do not pass through the schools, who, as a rule, are capable of displaying an acute intelligence, and a thoughtfulness which have nothing in common with scholastic training, but are acquired by the primitive methods of keen observation, and a perpetual intercourse of man with man."

ARTISTS AND STUDENTS IN ITALY.—Mr. Consul-General Neville-Rolfe is anxious to make it generally known that the new regulations for the admission of artists and students gratis to the Italian galleries and excavations are much more stringent than they have been hitherto. In the case of artists and students they should now submit their credentials to the Italian ambassador in London, and on his certificate a pass will be granted. Until lately the certificate of the Artists' Consul was accepted. Now, unless the artist has provided himself with a certificate from the Italian Ambassador in his native country he must make his application to the ambassador accredited to the Court of Rome, who must first judge whether the applicant belongs to a "recognised academy," and if in his judgment he does so, forward his application to the Minister of Education, who eventually sends a pass to the Embassy where it is usually forwarded to the Consulate of the city from which the application is made, and then by the Consul transmitted to the applicant. The pass when obtained permits the bearer to measure, sketch, and photograph, and to go in and out of the gallery or excavation free as often as he pleases. If he wishes to copy a picture he must apply to the Director of the Gallery in which it is exhibited, who will inform him under what conditions he may work. Amateurs can obtain admission to photograph on application to the Director of the gallery or excavation in question. The application must be on stamped paper of 60 c., which can be procured of any tobacconist in Italy.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

MARCH 29.—"British Woodlands." By the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P. R. C. MUNRO-FERGUSON, M.P., will preside

APRIL 5.—"Ancient Architecture of the Great Zimbabwe." By RICHARD A. HALL.

APRIL 12.—"The Industrial Resources of the State of Matto Grosso, Brazil." By GEORGE TORRANCE MILNE, F.R.G.S.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

APRIL 6.—"The Prospects of the Shan States." By SIR J. GEORGE SCOTT, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States. THE MOST HON. THE MARQUIS OF BATH, will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock :—

MARCH 28.—"The Manufactures of Greater Britain.—II. Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia. HON. SIR JOHN ALEXANDER COCKBURN, K.C.M.G., will preside.

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

APRIL 11, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR RENE LALIQUE (Paris). ARTHUR LASENBY LIBERTY, J.P., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

HERBERT LAWS WEBB, "Telephony." Four Lectures.

LECTURE III. — MARCH 27. — *Telephone Exchanges.*—Requirements of a telephone exchange—Early types of switchboard—Evolution of multiple switchboard—Switchboard signals—Automatic signals—Various types of exchanges—Various methods of operating—Common battery exchanges—Distribution of wires—Power plant—Telephone buildings—Automatic exchanges—Conduct of telephone traffic.

LECTURE IV. — APRIL 3. — *Development and Tariffs.*—Supremacy of telephonic communication—Essential features of modern telephone service—Organisation of telephone plant and business—Evolution of telephone rates—Scientific telephone tariff—Effect of area on cost—Varying demands of consumers—Graded classes of service—Telephone development in different countries—Long distance service and rates.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures. May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures. May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. Herbert Laws Webb, "Telephony." (Lecture III.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. F. Oliver Lyons, "The Rating of Railways—their Over-Taxation; its Causes and its Remedies."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, 5 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Hon. Walter Hartwell James, "The Manufactures of Greater Britain.—II. Australasia."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. W. E. Dalby, "Vibration Problems in Engineering" (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. C. S. R. Palmer, "Coolgardie Water Supply."

United Service Institution, Whitehall, S.W., 3 p.m. Major the Hon. T. F. Fremantle, "Modern Military Rifles."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. C. K. Cooke, "Emigration of State Children."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. Frank Pink, "Bananas."

WEDNESDAY, MARCH 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Right Hon. Sir Herbert Maxwell, "British Woodlands."

Chemical, Burlington-house, W., 4½ p.m. Annual Meeting.

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Mr. D. Edwards-Radclyffe, "Ramie, the Textile of the Future: a Promising Industry for India."

THURSDAY, MARCH 30...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Mr. T. G. Jackson, "The Reasonableness of Architecture."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 31...Royal Institution, Albemarle-street, W., 9 p.m., Prof. Joseph Wright, "The Scientific Study of Dialects."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Furniture in Relation to Architecture."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Prof. David S. Capper, "First Report to the Steam-engine Research Committee."

SATURDAY, APRIL 1...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Some Controverted Questions of Optics." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 3, 8 p.m. (Cantor Lecture.) HERBERT LAWS WEBB, "Telephony," Lecture IV.

WEDNESDAY, APRIL 5, 8 p.m. (Ordinary Meeting.) RICHARD N. HALL, "The Ancient Architecture of the Great Zimbabwe."

THURSDAY, APRIL 6, 4.50 p.m. (Indian Section.) SIR GEORGE SCOTT, K.C.I.E. (Shway Yoe). "The Prospects of the Shan States."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 27th inst., Mr. H. L. WEBB delivered the third lecture of his Course on "Telephony."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, March 28th; The HON. SIR JOHN ALEXANDER COCKBURN, K.C.M.G., in the Chair.

The paper read was "The Manufactures of Greater Britain. II.—Australasia." By the HON. WALTER HARTWELL JAMES, K.C., Agent-General for Western Australia.

The paper and report of the discussion will be published in a future number of the *Journal.*

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

THE SOCIETY OF ARTS AND THE LONDON INSTITUTION.

The Council think that the members of the Society may desire to have some information about the proposal which has lately been made for an amalgamation of the London Institution with the Society of Arts, and they therefore think it well to submit to the members generally the following short report on the question as it now stands.

In the latter part of last year an informal suggestion was made by Mr. W. T. Shaw, a member of the Society, and one of the proprietors of the London Institution, that the Institution and the Society should in some way or another unite their forces and combine into a single body. After a certain amount of private discussion, the proposal was submitted to the Board of Managers of the London Institution and to the Council of the Society of Arts, and it so far commended itself that both bodies agreed to the appointment of a committee composed of representatives of the two bodies for its further consideration. Such a committee was accordingly appointed in November, the representatives of the Society being—The Right Hon. the Lord Chief Justice, G.C.M.G., Sir William H. Preece, K.C.B., Sir Owen Roberts, M.A., D.C.L., F.S.A., Sir John Wolfe-Barry, K.C.B., F.R.S., and Sir Henry Trueman Wood (secretary); and those of the London Institution—William Henry Smith Aubrey, LL.D., Frederick Hovenden (honorary secretary), Cecil Frederick Joseph Jennings, C.C., William Thomas Shaw, Major John Amory Travers, and Robert W. Frazer, LL.B. (secretary). This Committee has held three meetings, at all of which the Lord Chief Justice presided, and eventually they submitted an identical Report* to the governing bodies of the two Institutions. This Report recommended an amalgamation of the two Corporations, and indicated the

* A copy of this Report will be sent to any member who likes to apply to the Secretary.

lines on which such an amalgamation might be carried out.

The Report was approved by the Board of Managers of the London Institution on February 9th, and by the Council of the Society of Arts on February 13th; after which the proposal was submitted to H.R.H. the Prince of Wales, the President of the Society, and received His Royal Highness's approval. In each case it was decided that the matter should be submitted for decision to a General Meeting of each body. The Annual General Meeting of the London Institution will be held on the 28th of April next, but the Council understand that the proposal will be considered, and a decision taken, at a special meeting to be summoned for the purpose on the 12th of the month. The Annual General Meeting of the Society of Arts will not be held until the 28th of June, and the question can either be submitted to the members of the Society on that day, or, supposing that the proposal is approved by the Proprietors of the London Institution, at a special meeting which the Council are quite prepared to summon, if necessary, at an earlier date.

The opinion of counsel has been taken as to the best means of carrying out a combination such as has been suggested, and the Committee has been advised that the most convenient and probably the least costly method would be to obtain an Act of Parliament. The Proprietors of the London Institution will therefore be asked to authorise their Board of Managers to promote an Act, and, if they agree, a similar proposal will be submitted to the general meeting of the members of the Society of Arts.

The Council, however, do not think that they should wait until a general meeting can be summoned before they inform the members as to the reasons which have induced them to regard favourably a proposal of so important a nature, and one which will have such great influence on the future of the Society. It is no small matter to break with the traditions of a century and a-half, and to make a new departure at a time when nothing seems to call for sweeping change. As the members can well understand, it was not without very careful consideration and some hesitation that the Council accepted a proposal involving such novel conditions. For the Society is now in a very prosperous condition. Its members are as numerous as they have ever been since the foundation of the Society 150 years ago. Its finances are sound, for though it possesses no endowment, and its margin of income over expenditure is not large, it has been able in the course of the past twenty years to accumulate out of its income a reserve fund of more than £20,000. This has been effected in despite of the fact that the Council have always felt that it was the duty of the governing body of the Society to expend on the members the income which the members provided, and not to attempt to build up a large accumulation out of current revenue. They have no reason whatever to anticipate any falling off either in the number of members, or in the revenue of the Society, or to expect that the Society will be less prosperous in the immediate future than it has been in the immediate past. It is certain therefore that they have no cause for recommending to the members any change which would involve any considerable alteration in the work of the Society, or any cessation of the various lines of work to which it has devoted itself.

There was, however, one particular point which appealed very strongly to the Council. As the members are aware, the Society's present premises, which were built for the Society in the year 1775 by the brothers Adam, are not its own freehold. The original lease, granted for 99 years, expired in 1867. It was renewed that year for a period of 30 years, and this period came to an end in 1897, when the lease was further renewed for a period of seven years, ending in 1904. The Society's landlord, Mr. George J. Drummond, felt himself unable, without injury to the other portions of his estate in the Adelphi, to lease a portion of it for a lengthened period; and at the present time the Society are practically tenants-at-will, with an option of the tenancy being terminated at two years' notice on either side. The Council think it right to say that they fully appreciate the motives which have actuated Mr. Drummond in the matter, and they feel that the Society is indebted to him for the very liberal and friendly way in which they have always been treated; but, at the same time, the situation cannot be regarded as a satisfactory one, either for landlord or tenant, and the Council therefore would welcome any proposal which would ensure the Society in the possession of suitable premises, either on the present site, or in some other suitable position. It must, however, be remembered that the present building is quite inadequate for the growing needs of the Society. The meeting-room is sufficient for

all except exceptionally large meetings, and there is no complaint to be made about its convenience. As much cannot be said for the Society's offices, which are quite insufficient for its present work. There is also very poor accommodation for the library, in fact the accommodation is so lacking that it has been quite hopeless to attempt to keep the library up to date in the way in which it ought to be kept. Nor is the accommodation for the members themselves by any means such as they have a reasonable right to expect. There is really no convenient room for the members' use, and, as a consequence, the premises of the Society are not nearly as useful to the members as they ought to be.

The London Institution, though a good many years younger than the Society of Arts, has yet a most distinguished record. For many years after its establishment, in 1807, its laboratories afforded valuable means for chemical and physical research, while it has always provided for the public lectures on subjects of Science, Literature, and Art, delivered by the most distinguished men and attended by large audiences. It is merely its position in the heart of the City, in a locality which the permanent residents have now for some years deserted, that has militated against the continuance of its useful and prosperous career. The site of its buildings in the very heart of the City, is, of course, for business purposes, of very great and increasing value, and it is probable that, whatever might be the future of the Institution, its proprietors would find it desirable to leave the building in Finsbury-circus, realise its value, and establish themselves elsewhere. But if they were to move into the western district of London, they would find themselves in the midst of other societies, established for similar purposes, and doing the same work. It is presumably this consideration which has led them to suggest an amalgamation with another similar body, rather than to add one more to the numerous scientific institutions now established in the western part of the metropolis.

The Council have no doubt that the union of two Institutions, both in a prosperous condition, and having behind them a long record of useful labour, would, if properly carried out, produce an Institution of very great influence, and capable of carrying out public objects of the very greatest value. At the same time they would hesitate to recommend the amalgamation to the approval of the members if they felt there was any probability of the various departments of the Society's present work being abandoned, or even minimised in value. They would hope that the new Institution, if established, would carry on the meetings at which so many of the applications of Science to practical purposes have been introduced, or described, to the public; that the Cantor Lectures, which now form an encyclopædic record of the progress of Applied Science for the past half century, would still be continued; that the *Journal*, though it would probably be enlarged both in size and scope, would lose none of the useful features which have distingushed it since its establishment in 1852; that the Society's examinations, which have assumed during the past few years such an unexampled development, would be continued; and that no change would be made in the work of the Indian and Colonial Sections. But on the other hand the Proprietors of the London Institution would naturally expect that the work to which their Corporation has devoted itself, would in like manner lose none of its importance, and that the scope of the new Institution should be extended so as to include lectures on matters connected with Pure Science, Art and Literature, which have not hitherto been considered to come within the scope of the more practical Society of Arts. The magnificent library of the London Institution, containing over 100,000 volumes (besides the circulating library of 37,000) would be supplemented by the library of the Society of Arts, and its value still further increased. It may also be hoped that the resources of the new Institution would permit of the promotion of scientific research, once a main object of the London Institution, but of late years perforce abandoned by it.

Special stress must be laid on the consideration that the union, if effected, would be an amalgamation of two powerful Institutions, and not an absorption of one by the other. The objects of the two Institutions are of so similar a nature, and their membership is of so closely allied a character, that there is little fear of any difficulty on this score, or any reason to apprehend that the objects which specially appeal to the members of either Institution would be neglected in consequence of the overpowering influence of the other.

As to the place where the new Institution might establish itself, nothing as yet can well be said. Associated as the Society has always been with its historical premises in the Adelphi, it would naturally be a wrench to a majority of its members if that association were broken;

and it is possible that if after full consideration the proposal commended itself to the representatives of both Institutions alike, arrangements might be made for obtaining a sufficiently large area on the Adelphi estate. If, on the other hand, it was found necessary to move, there can be but little doubt that a suitable site ought, without much difficulty, to be found in some other convenient locality.

Looking at the matter as a whole, the Council think that the new departure, startling as it may seem to many of the members, is one which ought to recommend itself to their approval, and they trust that it may be found to offer as many advantages to the proprietors of the London Institution as to the members of the Society of Arts. How and in what directions the new Institution could most usefully develop only the future can tell. That must depend on the wisdom and the care of those who may be called upon to direct its course. At all events, a confident anticipation may be expressed that among the governing bodies of the two Institutions material may be found for the formation of a new governing body, able and willing to devote itself to the promotion of the various objects for which the two corporations were founded, in the same way as the managers of the London Institution and the Council of the Society of Arts have devoted themselves to the promotion of similar objects in the past.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, March 21st; G. F. BODLEY, R.A., in the chair.

The paper read was—

WEST COUNTRY SCREENS AND ROOD-LOFTS.

BY F. BLIGH BOND, F.R.I.B.A.

In introducing the subject of West Country Screens and Rood-lofts, a few preliminary remarks upon screen work in its more general aspect may not be out of place.

The chancel screen is a feature common to Christian churches of all lands and times; but whereas in some countries it is exceptional in its occurrence, in Britain it is very frequently met with, and would appear to have been well-nigh universal in former days—forming one of the most essential features of the English parish church.

In spite of the ravages of time, fire, iconoclastic zeal, and last—but not least in its destructiveness—nineteenth century "improvements" and "restorations," it is estimated that there yet remain some two thousand screens or parts of screens in our churches, and of these the West Country furnishes a large proportion, Devonshire alone contributing nearly two hundred (some of course mere fragments) and Somerset about half that number. This abundance of screen-work seems to be traceable to the strength of Oriental influence in the early British church, which laid the foundation of many peculiarities of plan and arrangement that differentiate our churches from their continental neighbours.

The earliest church builders appear to have been largely influenced by Hebrew tradition, and to have based their plans upon that of the Jewish Temple, with its tripartite divisions, separated by veils, and we find the use of veils, and of screens as a substitute for veils, perpetuated not only in the Eastern churches of later times, but in the early and mediæval churches in these islands. Early records testify to the fact that in the Celtic church a solid screen or barrier was built between nave and chancel.

The churches of those days were not stone built, but were of wood, or wattle, and it would appear likely that wicker-work was largely used in the construction of the lighter parts, as, for example, partitions and screen-work. The many remains of Celtic ornament or decorative detail as applied to stone, seem to suggest this, as they exhibit representations of twisted or plaited work, interlaced twigs and tendrils, &c., and in some cases these are elaborated into patterns very similar to those we find in the West Country wood detail of a far later date. The sculpture on the tomb of Cormac (Rock of Cashel) furnishes a good illustration of the earlier form of ornament, and illustrations of its later counterpart are here given, in the detail from the screen now at Whitchurch, South Devon, and that of Newtown, Montgomery (Figs. 1 and 2).

The west and south-west of Britain were the stronghold of the Celtic race, after the Saxon invasion, and in these districts the older Church and its traditions were never so completely uprooted as in other parts — consequently we may expect to find that local types of church building and of decorative detail would

exhibit their characteristics. In addition to this, the native stone of the West—in Wales, Cornwall, and Devon—was chiefly of a rough and intractable nature, incapable of being wrought into fine forms by the mason or carver —hence in these districts the mason's art was not brought to so great a pitch of excellence as it was elsewhere, and it naturally follows that more attention was lavished upon the wood-work.

We may thus discern two reasons for the peculiar abundance and excellence of the West Country wood-work, of which the mediæval screens and rood-lofts furnish the choicest examples, these having been from the first objects of especial regard and veneration, towards the beautifying of which every effort was made.

Parallel instances may be found in Brittany, where there exist a number of fine screens having features in common with the West British, the same conditions as race and soil here holding good.

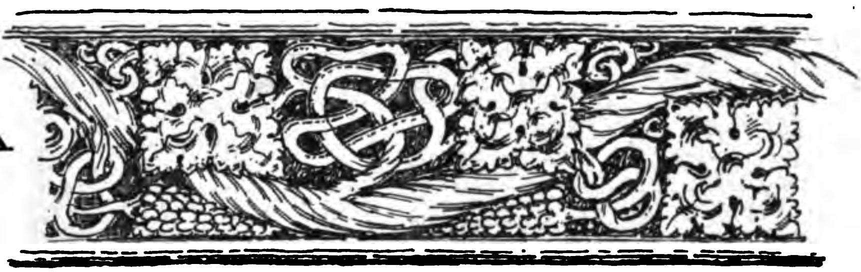
Saxon and Norman building traditions are chiefly concerned with the mason's art, and there appears little in the character of the decorative detail they employed to suggest a derivation from wicker-work or tendril forms; but in spite of the powerful influence of the style introduced by the Romanesque builders, the oldest British forms and ideas seem to have held their ground, and gradually leavened the whole of our national church architecture, giving a peculiar type of plan in which the high chancel screen is universal, screen-work of wood or stone being found in every part of England, but nowhere more abundantly than in the western districts.

There was a type of stone-built church common in Britain in early days, in which a solid barrier of masonry was built between nave and chancel. This was pierced by a single opening, not much wider than an ordinary doorway. In this we seem to discern the prototype of those heavy stone screens which are occasionally found in our country churches. Stone screens, are, however, of unusual occurrence in the West of England, though they are found in certain localities, as North Wilts, and South Somerset. Some of these are of early date, and were originally double screens supporting a gallery over, thus forming the earlier type of rood-loft as associated with the parish church.

One perfect specimen of this order remains at Compton Bassett, Wilts. The eastern

Fig. 1.

A



Detail from Whitchurch, South Devon.

Fig. 2.

B

Detail from Newtown, Montgomery.

member, forming the screen proper, consists of a wall, with central doorway, and traceried sidelights, below which altars formerly stood. To the westward is an open screen of three arches, highly enriched with sculpture and ornamental mouldings. A parallel instance is found at Le Folgöet, Brittany, which shows the altars, missing at Compton, but here in their ancient and customary position.

Of this arrangement of altars we have an instance at Patricio, in Monmouthshire, but here the screen itself is of wood, and is only a single screen. But the type of church most common in the West had no stone-built chancel wall such as that other early type I mentioned, but was a clear parallelogram of uniform width and height from end to end without any internal break, so far as the masonry was concerned—the roof, undivided by any chancel arch, ran clear from end to end, but the confines of the nave and chancel were clearly marked off by the closely-traceried screen which crossed the church at this point. This arrangement is well seen at Llanegryn. (Fig. 3.)

The abundance of wood screens in the West is very noticeable, and both in Wales and in Devonshire, districts retaining them in large numbers, they are associated with the type of church above described.

Those which survive are chiefly of the fifteenth or sixteenth centuries, two causes having operated to reduce the amount of earlier work.

In the first place—natural decay; in the second place, the removal of the earlier screens for the more extensive and complex structures of later times. The latter fact was observed and commented on by the late G. E. Street.

The very general rebuilding of West Country churches, or their enlargement by the addition of aisles in the fifteenth century, also accounts in a great measure for the disappearance of earlier work. This is notably the case in Devon and in Somerset, in which counties we may nevertheless find still a few excellent specimens of wood screen-work prior in date to the fifteenth century. That at Wellcombe, in Devon, may be considered very early. It is simple and rough in execution. The parcloses at Ottery St. Mary are of massive fourteenth century type, also the older screen at Mere, in Wilts (not the present rood screen).

Later we find screens such as those now arranged as a parclose in the church at Bridgewater, in which the work is still of a massive type, exhibiting features akin to stonework detail. Wood detail begins as an imitation of stone, and in its earlier periods is extremely massive, comparatively coarse in execution, though sometimes wonderfully undercut after the manner of freestone, but gradually we find

FIG. 3.

SCREEN AT LLANEGRYN.

it exhibiting more refinement of character and skill in execution, the design becoming more easy and natural, and the proportions lighter and more closely adapted to the nature of the material, and expressive of its qualities. We can discern this progress in viewing the detail of the parclose screens at Halberton, and the chantry screen now standing in the south transept at Dunster.

In the period of mature design which we are now approaching, it may be claimed that there is a very perfect and intimate correspondence between the character and detail of the West Country wood-work and the nature of the oak in which it is wrought, there being a virility and forcefulness in the design, and a "verve" in the execution which are highly suggestive of the vigour of living forms, and have therefore great interest and value to the artist or art student.

This quality is by no means so well developed in other districts—or parts of England—where the detail is too often merely imitative of stonework, and exhibits a comparative weakness and poverty of design, features of a harsh character, and possessing little interest, such as buttresses, battlements, water tables, and others of a like order, which are proper to stonework, being reproduced on a minute or attenuated scale, with much repetition. These features are apt to give a hard and mechanical feeling to wood-work, a feeling which is increased when the mouldings employed are hollow, or angular, but which can be greatly modified by a judicious use of foliage forms and enrichments.

The West Country work is distinguished not only by the absence, to a large extent, of these mechanical and imitative features, but also by the universal employment of convex mouldings, beads or ogees, which are destructive of any tendency to harshness of effect, and bold convex profiles in the scrolls and vignette enrichments.

But in the earlier wood-work some imitation of stone is only to be expected seeing that the arts of joinery and wood-carving were in process of development in England during the thirteenth and fourteenth centuries, and only reached their climax in the early fifteenth century, after the period at which stone-work had attained its best development.

We may now turn to the form of the earlier screens. Most of the wood screens of the fourteenth century would appear to have supported a loft or gallery to the westward, or centrally over the screen. The screens themselves have horizontal framed heads and the loft would have had a flat soffit. (Fig. 4.)

There are several such early screens in Devon—as Wellcombe, Braunton, Budleigh, &c. That at Stoke-in-Teignhead (Fig. 4), is said to date from Richard the Second's reign, and until its restoration it supported a narrow gallery. The little screen at Culbone probably upheld a similar gallery, and there are others of these square-headed early screens in Somerset, at Pawlett and Huish Episcopi, the latter said to have been removed from Enmore, whilst the northern part of the country is full of screens or remains of screens of a peculiar, and, I think, later type, of which Priddy, Wellow, or West Pennard churches afford examples. These consist of a number of narrow vertical divisions having narrow lights, square-headed, and containing tracery with crocketted canopy heads to the lights.

The galleries over the screens of this class were probably raised upon a coved soffit, as we see at Christian Malford, Ashchurch, and elsewhere.

In Wales, we meet with many screens of the Llanegryn type, carrying wide lofts with flat soffits, placed centrally over them, and sometimes supported, as at Llanwnog, by legs at front and back. Next comes a more elaborate type, which has arcading within a square head, as at Exbourne and Bow in Devon, and Keynsham, Ashton, and Wrington in Somerset, and in these the loft in most cases stood centrally over the screen supported by coving back and front. Lastly come the magnificent groined screens for which Devon is so famous, and these mark the climax of the art. The development of the groining compares very favourably with any specimen to be found in other parts of England, or with foreign screens; and the character of the ornamental detail, especially the vignette enrichments in the cornice, leaves little to be desired in point of excellence of design and execution.

The cornice enrichments here reproduced are from the screens at Atherington, North Devon. (Fig. 5.) I show a slide of the fine screen which stood in the church of St. Audries' West Quantoxhead, Somerset, before the rebuilding fifty years ago, and the fragments of which are now in the possession of Sir Alexander Acland Hood, by whose courtesy the author was permitted to take the photographs and measurements of the work.

The screens in the West Country are usually of great width, frequently being continued across nave and aisles from north wall to

south wall, whilst there is every evidence that the rood-lofts ran the whole length of the same. The screens generally exhibit a series of section, with moulded ribs and embossed or traceried fillings. Above these comes the beam which carried three or four tiers of

FIG. 4.

SCREEN AT STOKE-IN-TEIGNHEAD.

fenestrations with arched heads, subdivided by moulded standards supporting a close reticulated head of "perpendicular" tracery, and between these spring groinings of hexagonal vignette enrichment, divided by plain or twisted beads, and enriched by crestings at top and bottom, a choice and often highly ingenious design.

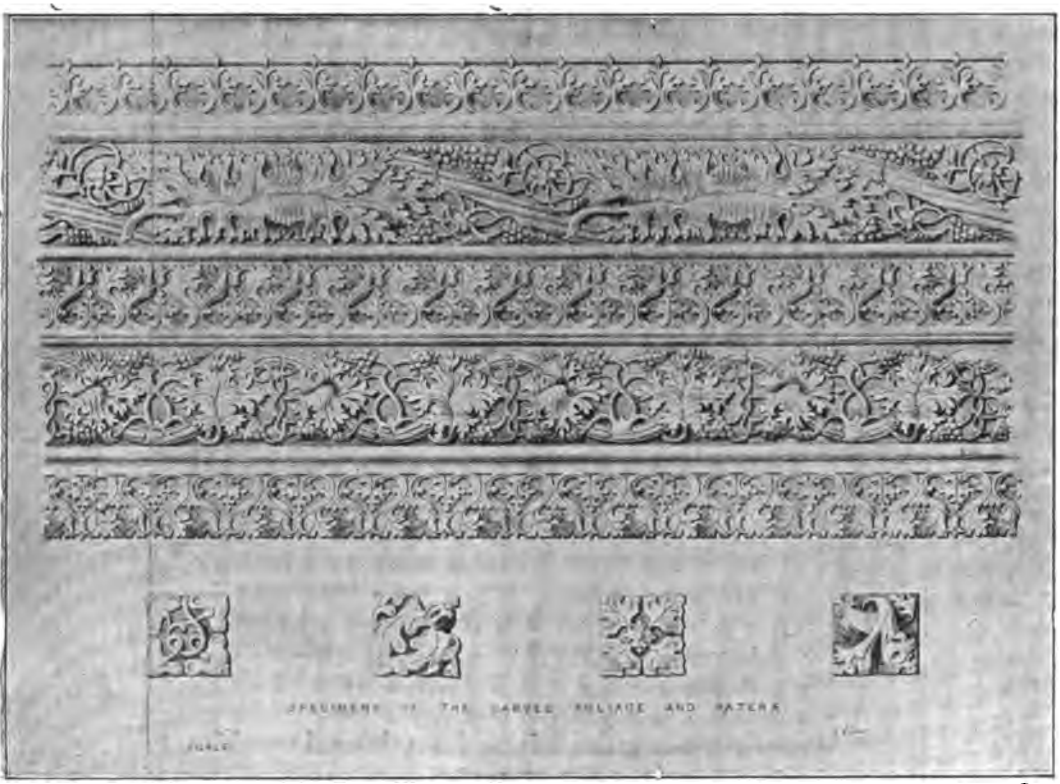
It is interesting to trace the types ruling in the different localities of the West Country, as these exhibit some totally distinct schools of design. Those of Devonshire were roughly classified by the author of this paper, in the Devonshire Association Transactions for 1903.

There are several leading types of work purely English in character, of which those of Kenton, Kentisbere, and Hartland may be singled out as representative specimens; In the case of Kenton there is a screen of which the whole framework and most of the detail are English, while small portions betray a Flemish character.

Italian detail is found at Marwood (Fig. 6), Atherington, and elsewhere in the fillings of the groining, whilst at Aveton Giffard (Fig. 7) and Kingsbridge we have a French type.

There are a group of screens in Mid Devon, at Colebrooke, Coleridge and Brushford, which

FIG. 5.



ATHERINGTON CORNICES.

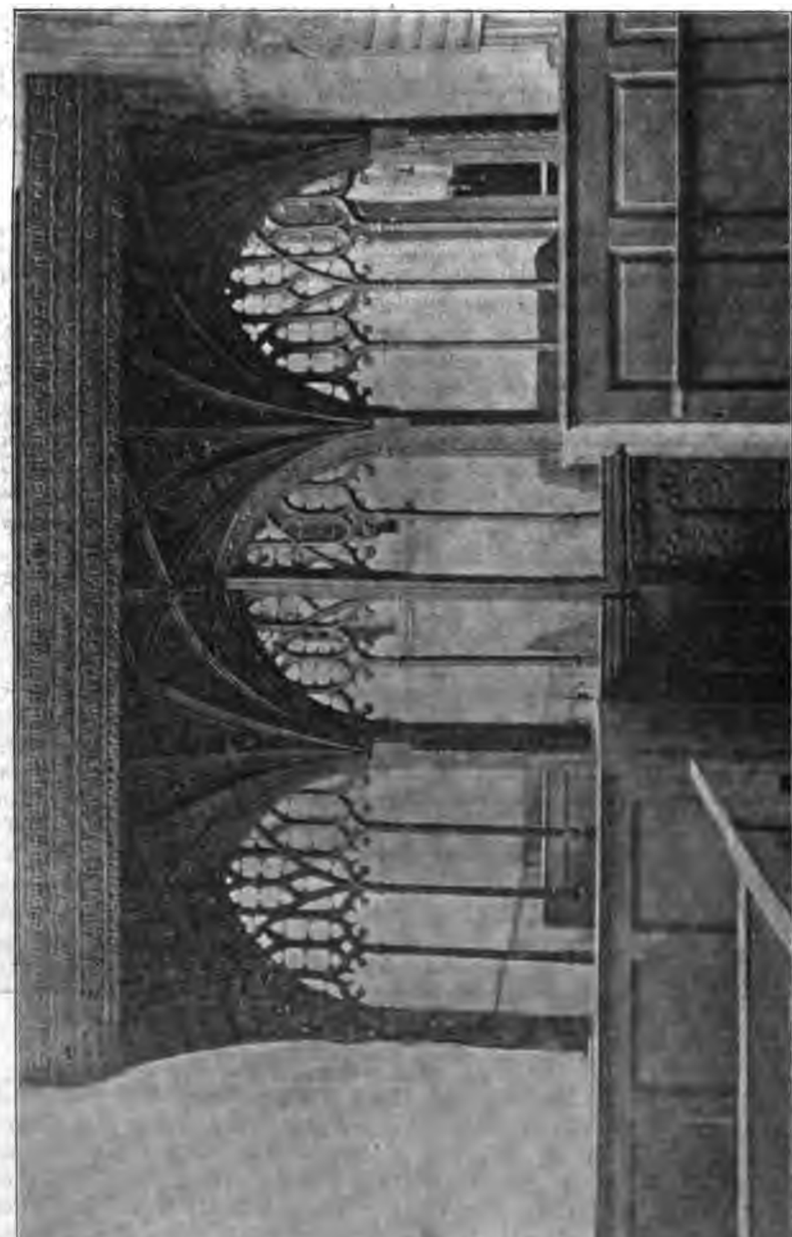
whilst at Swymbridge and Bridford we find a highly enriched variety, literally encrusted with carving, and differing widely in detail from the usual type. Somerset gives us a series of great dignity and distinction of character in the tall transomed screens at High Ham, Queen Camel, Mere, and others: whilst occasionally, as at Fitzhead, we find a screen entirely unique.

There are also a large number of screens, chiefly, I think, of late date, in which foreign detail is conspicuous, and in some of these there seems to be actual foreign workmanship. have a character akin to the French *flamboyant*, but with a curious Moorish or Oriental feeling about them. The tracery is subdivided, there being a main order of flowing or reticulated design, filled with a minute fretwork of similar form. A screen at St. Fiacre, in Brittany, exhibits detail closely analogous to these.

The English fifteenth century type conforms to the "perpendicular," but in some late cases there is a tendency to a debased decorated type of tracery, with detail coarse and ill executed. This appears in the parclose screens

at South Milton and West Alvington, both, I think, very late work. The Cornish work partakes of this nature, the tracery of the St. Buryan screen showing it; also that at St. Ewe. Unfortunately, Cornish screen-work has mostly disappeared as the result of nineteenth century vandalism.

Fig. 6.



Screen at Marwood.

The gallery fronts which surmounted the beam were of extremely rich design, and on them resources of the wood-carvers', painters', and gilders' crafts were expended, producing an effect of great magnificence.

The usual arrangement seems to have consisted of a series of panels, sometimes pierced with tracery, sometimes embossed, but for the most part painted with figures of saints or Scripture subjects, those in Devonshire following as their prototype the jubé in Exeter

Cathedral, which exhibits a series of Old and New Testament subjects. These panels would be surmounted by canopy heads of the finest tabernacle work, and divided enriched standards, as we see in the old gallery at Atherington and restored rood-loft of Kenton or Staverton. At the top there would be a running ornament with a tall cresting over it.

These paintings would have afforded a valuable means of instruction for the unlettered rustics of former times, and have been termed "The Poor Man's Bible."

An illustration is given of the screen and loft recently erected at Lew Trenchard, for the Rev. S. Baring Gould, in which the author has endeavoured to reproduce this ancient feature. (Fig. 8.)

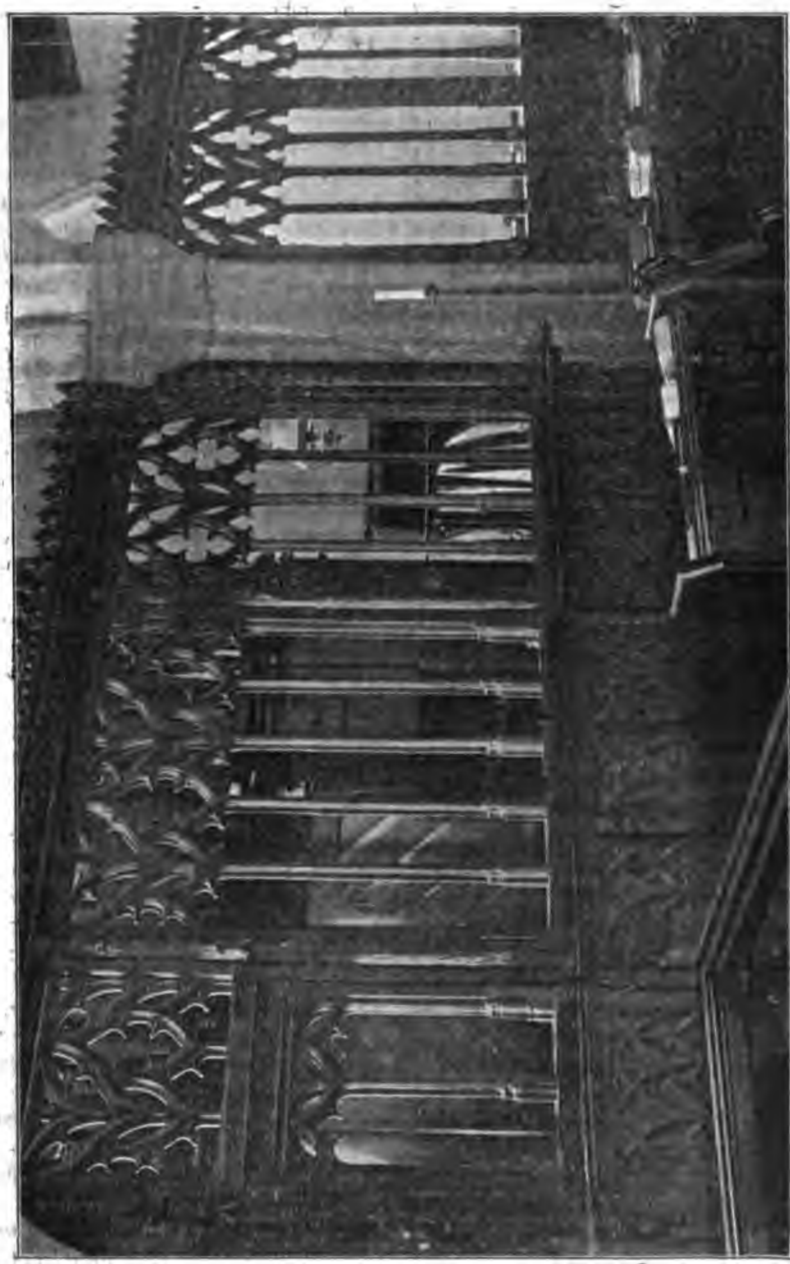


Fig. 7.

Screen at Aveton Giffard.

Much fine work remains in Wales where the rood-lofts have survived in many cases and exhibit some remarkable detail. Those at

Llanegryn (east side), Llanwrog, and Llangwm are typical specimens, having pierced traceried panels. Few remains of rood-lofts in Devonshire at the present date. Atherington, the best preserved, retains both balcony fronts, nothing having disappeared, but the statuary or original paintings, which have been replaced by heraldry, scrolls, and inscriptions of Elizabethan date.

Another at Marwood was taken down within living memory and several more are known to have been standing at no very distant date.

The balcony over the eastern side is still standing, however, and is a quaint and curious piece of work, evidently of late date, the panels being filled with rudely-carved grotesques.

The rood-lofts which, prior to the Reformation period, had been employed for numerous purposes, mostly of a nature afterwards judged to be superstitious, appear nevertheless to have fulfilled a special function of more lasting importance in providing accommodation for choir and organist, with perhaps other musicians.

In this use they were frequently confirmed, it would appear, after the Reformation, being extensively used for the purpose, and no doubt many only disappeared because they were worn out. The order of Archbishop Parker that the rood-loft fronts should be taken down as far as the beam and finished with a convenient cresting was generally, but by no means universally, complied with, and this was especially the case in Devonshire where a great many were retained as singing galleries or pews, as at Tiverton, Cullompton, and Totnes, whilst others were simply removed to the west end of the church. It has been considered that the order for their removal was not aimed at the lofts, as lofts, so much at those superstitious accessories, which were often a part of their structure, and thus necessitated in many cases the demolition of the entire fronts.

It seems odd that whilst the paintings or sculptures over the screen fell under such complete condemnation in Edward VI.'s and Elizabeth's time, the figure paintings which adorned the lower panels of the screens were not ordered to be destroyed. Such mutilation as they have received appears to have been chiefly at the hands of the Puritans, and many series of such figures yet remain in Devonshire, as well as East Anglia, to gladden the heart of the antiquary. These paintings have been ably and exhaustively dealt with by Mr. C. E. Keyser, F.S.A. ("Archæologia," vol. lvi., 1898).

There was a strict injunction that the screens themselves were in all cases to be retained, and we find that not only were they not destroyed at the Reformation, but a great many were erected during the Reformation period and subsequently these may be classed in order of date as the sixteenth, seventeenth, and eighteenth century types, illustrations of which are given in the screens at Lustleigh, Rodney Stoke, Washfield, Low Ham, and Cruwys-Morchard. The screen at Lustleigh shows the Gothic traditions in its general form and detail, but with altered features according to Reformation ideas, figures of choristers and clergy being substituted for saints on the lower panels. That at Washfield illustrates the Jacobean type, in which a greater departure from old models is of course noticeable. In the screen at Rodney Stoke we see the effect of the revival of Catholic ideas under Archbishop Laud, there being here a Post-Reformation loft above a screen of the same date (Fig. 9). Other fine types of post-Reformation screen-work may be seen at Croscombe, Crowcombe, and Bridgwater.

The attempt to reproduce some of the characters of fifteenth century enrichment is noticeable in the cornices, but the immense difference is apparent, the seventeenth century imitation being flat, coarse, and superficial, and yet having a by no means ineffective character. It illustrates, however, the great decadence in the native arts since the days of the Tudors.

The example from Low Ham is even more interesting, as here is a church with internal fittings complete, in Caroline Gothic. The screen is well worthy of study. At Cruwys Morchard we see one of the instances—few in number—of a screen with parclose, stalls, &c., erected in the Hanoverian period. This was an age of apathy in church matters, when old landmarks were in process of being forgotten; and although such instances as this exhibit a continuity of old tradition, yet, as far the characteristics of West Country screenwork are concerned, this work cannot claim to be a successor, as it is purely Italian in design.

The West Country type of church having as a rule no chancel arch, its place was usually taken by a partition extending from above the screen to the apex of the roof. There are good ancient instances of this at Bettws-Newydd, and at Mitchelddean, whilst Littleham (Bideford) provides a modern one. This may be called a tympanum of the screen. On this it was customary to depict the Doom, and

FIG. 8.

SCREEN AT LEW TRENCHARD.

FIG. 9.

SCREEN AT RODNEY STOKE.

against it or in front of it, on the western side, would stand the Holy Rood with figures of St. Mary and St. John.

At the Reformation these tympana were despoiled of their superstitious paintings and their surfaces were whitewashed or plastered, and the tables of the Law, with the Royal Arms, the Creed, and the Lord's Prayer attached to them in accordance with the decree of 1604. Illustrations of these tympana are given from Llanelieu, near Brecon, an ancient and unaltered example; from Wenhaston, showing the Doom—next, a Post-Reformation example from Bridestowe with a painting of the Resurrection; and from Parracombe, shewing the usual Post-Reformation tablets together with others, but it is to be regretted that during the earlier "Restoration" period in the nineteenth century, the greater part of these disappeared, being considered an obstruction by the clergy of those days who had lost sight of the old traditions and failed to see the necessity of a barrier between nave and chancel. Much mischief also has been done by the hasty and injudicious repair of screens, and to save the cost of restoration they have frequently been cleared of their ornamental detail. Sufficient nevertheless remains to form an artistic storehouse of the greatest value, and it needs but a careful and attentive study of the West Country screen-work to demonstrate its very high importance to those who are seeking to revive those beautiful handicrafts which were the pride and joy of our forefathers, but which has since fallen so lamentably into abeyance.

In these beautiful compositions we find a richness and variety which cannot fail to satisfy, combined with a remarkable honesty of design, and all the freedom from affectation which differentiates a native from a borrowed style. They remind us of those ineradicable principles in art which connect the form and proportions of a design with the nature of the material in which it is wrought, and regulate its character in truth, fitness, and harmony, offering in these respects, it may be feared, a rather painful contrast with much that unfortunately distinguishes modern compositions—especially those of a school which aims at emancipating itself from ancient rules.

DISCUSSION.

The CHAIRMAN thought the paper was a most able and interesting account of the old screens in the West of England churches. It not only dealt with the history but also with the art of the subject. The running vine patterns were full of beauty. He had examined some of them and might remark that he had some delightful carved fragments of them in his office which were given him by the late Lord Devon. They were almost always gilded on red which gave a warm tint. There were two very different ideas of the interior of a church. The one was to have it all open to view, so that it might appear spacious and grand, and present an uninterrupted vista. That was the classical, and is the modern idea. The Gothic plan is the opposite to this. Here the interior is screened and we have the conception of mystery—an indefinite space beyond. A dark screen may stand up against a bright golden east end. If Nature was to be the guide in art, there can be no doubt that the screened effect is the one most in accord with it. The Chairman further said that he remembered walking on a road that wound its way half up a great hill that rose out of a vast level landscape. Between him and this wide view of long stretching land there were trees standing, screenlike, with their high stems, and the tracery of their branches. They stood out dark against the background of the vast stretch of land that was bathed in sunlight. Presently, as he walked on, the trees came to an end, and all the broad low-lying land was displayed to his eyes. The view was fine, but the entrancing beauty—the mystery of a half-seen view was gone. The poetry was turned to prose, and the richness of effect to comparative poverty. With the less seen view of the plain, the effect was one of indefinite, well nigh an infinite appearance of space and distance. But when all was seen there was a loss—a loss even of size and distance. The half had been greater than the whole as it often is in Art. Here then was the screen system as contrasted with the unbroken vista idea. How far more beautiful the screened scene was than the open one no words could express. While he was familiar with a few of the sreens that had been exhibited, he was a little sorry that more of the Eastern counties' screens had not been shown because he knew them best. The screen at Southwold was a great work of art. It was rather interesting that in that church there were two screens, the centre screen, and the screen at the side, which were entirely different. The centre one, which was a little earlier, was full of art, while the other was rude. He was sorry to have to say that he believed the painting on the centre screen was Flemish work and was almost worthy of Van Eyck or Memling; the painting on the side screen was English and was very rude and elementary compared with the Flemish work. He had much pleasure in proposing a vote of thanks to the author for his most valuable paper.

Mr. C. E. KEYSER thought the feeling which would be uppermost in the minds of the audience would be one of astonishment at the magnificence of the carving of the screens exhibited. There was no doubt that the screens of the West of England excelled most other work of the kind for the beauty of their

carving. He knew the eastern counties' screens well, and did not think there was anything in Devonshire which could compare with such screens as those at Ranworth, Southwold, Attleborough, and many others, but there was a certain special character about West Country screens which struck him as most peculiar. The Somerset screens he considered were more of the pure English type, and he did not regard them as so remarkable as the Devonshire and a few of the Cornish screens. There was a great question to his mind as to what was the influence which prevailed to bring about the carving and erection of so many screens within so very limited a period. He differed from the author in regarding a particular screen shown as of the fourteenth century. Although it was a variation of type, he thought it came within the period in which almost all the screens in Devonshire were carved and painted, which began about 1480 and went down to post-Reformation times. It was wonderful how the people of the little churches all round Dartmoor and all over Devonshire could have afforded to get men of genius to carve and paint the screens which were put in their churches. He was not prepared to think they were done by foreigners; he was one of those who liked to feel that in all times Englishmen were able to hold their own. There was no doubt, however, that, in Devonshire in particular, there was a foreign influence with regard to the screens, and this was shown more in the painting than in the carving. He had brought with him a number of drawings, which were made for him when he read a paper before the Society of Antiquaries on the subject of the figures which were painted on the screens. There was almost as much to be said with regard to the painting on the panels of the screens as of the wonderful varieties of their carving. If the figures were inspected, it would be seen that there was a certain foreign influence about them. Both the screens at Chudleigh and Bovey Tracey had figures of the Apostles and Prophets alternately, a subject which was found elsewhere in England. A great many saints were found represented on the Devonshire screens which were most difficult of identification. He went thoroughly into the subject about ten years ago, and managed to identify almost every saint which occurred on the panels of the screens. There were many saints portrayed who were much more popular in France than in Spain, Italy, or England; and as these were not found on the screens in the eastern counties, or elsewhere in England, he thought it might be said that at any rate, with regard to the people for whom the screens were painted, a certain amount of foreign influence was brought into play, and that possibly help was obtained from abroad in order to produce the subjects which were required for the different churches. He hoped they would be able to find out where the screens were made, by whom, and under whose care, because he could hardly believe that unless there was some special school of art at such a centre as Exeter, it would be possible for so large a number of magnificently carved screens to be produced within comparatively so short a time. The author had stated that the order that the screens were to be retained in the churches possibly explained why it is that so many still exist. There were a great many screens which were no doubt of post-Reformation date, and some of the paintings on them were of that date too. In Ugborough church between Totnes and Plymouth there was a screen with a painting of the Martyrdom of St. Sebastian, which occupied four panels of the screen; that was a subject which one would not expect to find in post-Reformation times. From the costumes in the painting there was no doubt they were executed at the beginning of the seventeenth century. Many of the screens had been subjected to cruel usage, had been either whitewashed or brown painted over; the paint had been afterwards scraped off, and some local artist thinking he could put the thing right had re-painted the whole series. That he thought was the case at Dartmouth and in the Church at St. Mary's Steps at Exeter. There was no doubt that local people had embellished some of the screens; they had managed to get the various washes off, and had then thought the right thing would be to paint the figures up, but as far as he had been able to ascertain many of the figures had been painted to represent quite different people from what were there before. But there was a mystery about the whole subject. Within a comparatively small district there were hundreds of beautiful screens with very little variation in the date at which they were put in. It was said that Henry VII. exercised a very great influence in the West of England; in fact, almost all the churches and towers in Somerset and Devonshire were rebuilt during his reign. There must have been a wonderful enthusiasm among the people, and they must have been very prosperous to have been able to rebuild nearly the whole of the churches in the western part of England and erect such beautiful screens. He felt most grateful to the author for having brought such an interesting subject before the Society.

Sir CHARLES KENNEDY, K.C.M.G., cordially agreed with the Chairman's and Mr. Keyser's remarks as to the excellence of the paper and the admirable way in which the subject had been presented. It was a very remarkable thing that within the space of about seventy years, such a large number of screens should have been erected in village churches in rather a remote part of England, which was not wealthy in the same sense as the villages of East Anglia were. It was possible that in the publication of the Diocesan Registers which was now taking place in Exeter, some light would be thrown by means of the authority given for the rebuilding of the churches and the erection of the screens, on the circumstances under which they were carved. If any member should happen to be staying in that part o

the country, with Exeter as the centre, there were several screens which could easily be seen on the North Devon line. For instance, there were the screens at Atherington, Kingsnympton, and Lapford, which were quite easy of access from railway stations. In South Devon, to the south-east of Exeter, there was the screen at Littleham, and further to the east the screen at Talaton, which was considered one of the best in Devonshire. To the south-west there were the screens at Kenn and Kenton, and on the borders of Dartmoor, three miles from Bovey Tracey, there was a remarkable screen in the church at Ilsington. As the author of the paper had stated, the peculiar fact was that most of the screens were of oak; he did not think there were more than ten stone screens in Devon. Very good examples of painted screens were to be found at Chawleigh and at Chulmleigh, two miles from Eggesford station. An excellent list of Devonshire screens was published in the paper which Mr. Harry Hems read before the Society of Architects on April 21st, 1896, and that gentleman had in his gallery at Exeter a collection of fragments of screens and of ecclesiastical woodwork, which he was always ready to show, and which embraced examples not only of present screens, but work which was now no longer to be seen in its entirety. When work of restoration was done, very often imperfectly, pieces were sometimes considered not to harmonise with the main part of the woodwork of the building, and were very ruthlessly cut away, and in that manner the continuity of ecclesiastical woodwork had been lost. As he lived in the county, he wished to say he had learned much and received great pleasure from listening to the paper.

Mr. Lewis Day, in supporting the vote of thanks to the author for his extremely interesting paper, said that with regard to the Renaissance character of some of the screens, the author seemed to argue that because they were of that character they must have been done by Italian workmen. That might have been the case in some instances; but he did not think it was necessary to imagine that Italian workmen were employed in order to explain the Italian character of the design. At that time the Renaissance detail was abroad; people were bitten by it, and pattern books of Renaissance designs were common. There was no doubt that the carvers of that period had those pattern books, and tried to do something Italian; and it would be noticed that the Renaissance character of the screens had a decidedly Gothic twang about it. It looked to him as if it was the work of Britishers trying to be Italian. The author had shown a screen from Colebrook which he suggested might be French. There was not the slightest doubt in his own mind that that screen was Spanish work, although it was impossible to explain why. He had been particularly interested in the tracing described by the author as minor and major, and also in some of the Welsh work, but he did not quite follow him in his remarks with regard to the return to the Decorated style in some of the Perpendicular work. It did not seem to him to be returning to Decorated work at all, but simply a lingering of the geometrical element which was the beginning of the Perpendicular. The great thing which struck him in regard to the work shown, generally, was the admirable simplicity of the carving and its comparative rudeness. Allusion had been made to the perfection and grace of the carving. He did not find the grace of it so prominent; there was a perfect mastery of the tool, and vigorous, manly workmanship, rather than refinement; and, if it was examined with a strict artistic sense, it proved very often to be overdone. But there was the beauty of vigorous, rude, simple work which any practical carver might have done, given the tradition of design. Somebody had asked how such work could have been done. He thought it was really the tradition that helped people to do the work; they did not bother themselves about originality, they simply went on doing the thing that was natural to them. It was tradition which enabled the work to be done; and where present day people were going wrong, was in dropping away from all adherence to tradition.

Mr. E. F. Strange, in referring to Mr. Day's remarks in regard to the want of grace in the carving of the screens, said the author had not shown a specimen of what he (the speaker) considered to be absolutely the finest wood carving in the whole of the West of England. He had ventured to bring with him a slide of the screen which was in the church at South Pool. From the view it would be seen that the carving must have been done by a man of great skill. It was completely under-cut; and local church decorators, who used the screen for the purpose of harvest festivals, had no difficulty in tying string round the tendrils for the purpose of hanging up flowers. With regard to the question of foreign influence, the author and various speakers had suggested that that influence had been Flemish, French, Italian, Spanish, and Moorish; but although traces of those influences had been pointed out in a few screens, he was not sure that anything more than casual and local coincidences had been proved. Every screen which had been shown had a skeleton of English work. The general plan, the framework, and all the setting was English. He would like to know whether it was suggested that two or three foreign carvers from different countries came over to England and executed small portions of the screens. Mr. Day had suggested the solution of a problem which the author considered difficult. He did not think it was necessary to look abroad for artists who made or decorated any of the screens in England. Pattern books were obtainable; the art of engraving was well established, and engravings were obtainable. But there was something more, which had not before been alluded to, which was not only obtainable, but was pro-

bably in existence in the majority of parishes in the country. The churches were well provided with funds at that period, as was proved by the frequent re-building of them, and the richness of their decoration; and there was hardly a church which did not possess finely illuminated books, which came from the continent in large quantities, although there was good writing and illumination done in this country. He ventured, therefore, to suggest that the theme of the work was often supplied to the local worker from the illumination of such a book; and that if it was not actually supplied in that way it was indicated to him by a foreign monk in one of the monasteries. He did not think the work was done by the monks, although it was extremely probable they might have suggested to a carver here and there themes which eventually became part of the tradition, and were handed on by him to his sons and his associates. In connection with the South Pool screen there was almost evidence of two generations in the three or four screens of the same kind that existed in the neighbourhood. He was glad to hear from Sir Charles Kennedy that Mr. Hems, who had restored many screens in his time, possessed a considerable gallery of fragments which he was willing to show to visitors to Exeter. He asked the audience whether they thought it creditable that a private gentleman should possess a gallery of such fragments, and that they should be grateful to him for being willing to show them, while none of the national museums possessed a single specimen.

Mr. H. LONGDEN stated that he had had the pleasure of visiting the church at Lower or Nether Ham, the screen of which had been shown. It was not the parish church, but a chapel situated in the middle of a field, without churchyard or enclosing wall, and belonged to the Lord of the Manor. The building is entirely of the date of Charles I., being in the imitation of Gothic which was done at that period. The screen was very interesting. The ornament and cresting were Renaissance, and the tracery was an amusing attempt at Gothic. He had inspected the screen at Holbeton in Devonshire with Mr. J. D. Sedding, and that gentleman was quite persuaded that the carving in the screen was Flemish. He did not wish to imply that the work on many screens should be attributed to foreign workmen, but he thought Mr. Sedding's judgment was worthy of attention. He wished to add his tribute of thanks to the author for his most interesting paper.

A MEMBER said he would like to remark with regard to the supposed unlikelihood of artistic workmen coming to this country in the early days, that it was well known from the history of Westminster Abbey that the monument of Edward the Confessor was ornamented somewhere about 1300 or 1308 by artificers who came partly from Venice and partly from another town in Italy. There was no doubt that artistic masons travelled all over the country in the early days, at all events in Scotland, which was proved by their work in the Roslin Chapel. He mentioned that fact to show the likelihood of artists moving about the country for the purpose of decorating screens, just as they decorated tombs.

Miss ROWE said that Mr. Day had expressed the opinion that the Colebrook screen was Spanish. She spoke with diffidence as she had never seen any Spanish geometrical tracery, but having seen and studied the Colebrook screen with very great care, she thought it was undoubtedly French. The way in which the little columns in the lights were carved was a very characteristic feature of the late fifteenth century French Gothic. Not one of the little columns in those days had the same pattern; there was a great variety in the twists and scales. That also applied to the Coledridge screen, which was on very much the same lines as the Colebrook, although it was not such fine work but rather coarser. In regard to what Mr. Strange had said, she thought with him that of the screens she had seen, the South Pool was the finest. It resembled very largely the screen at Dartmouth, and in her opinion the Portemouth screen came next with regard to beauty. In both these two examples the influence of the Celtic interlacement was very remarkable. Mr. Strange had referred to the under-cutting of the South Pool screen. From a practical worker's point of view she did not think the under-cutting was so wonderful as that gentleman thought. The carving was cut on a convex moulding about five-eighth inch thick, and she thought she had noticed some of the sections of the mouldings carved shown on one of the slides; therefore the back could be got at quite easily; the tools could drill the holes between the interlacements, and when it was carved it was fixed up on to a concave moulding. From the sections she examined in Devonshire she found that that was the principal treatment adopted in the fine screens which looked so elaborately under-cut. The question of the dates of the screens was a very perplexing one, and she would like to ask the author if he thought they ought to go by the paintings on the screens for the dates. It seemed to her that the paintings might be later than the woodwork, and might have been done *in situ* when the screens were put up. She thought with Mr. Strange that the construction of the screens was essentially English. She had never seen anything to beat the carving of the principal member of the South Pool screen. It was quite possible that foreign workmen might have done some of the work on the Atherington and Lapford screens, but she felt perfectly certain that the screens were English, although details like the paintings and some of the Renaissance carvings might have been done by foreigners; in fact, she even went so far as to suggest that the Renaissance ornament might have been filled in after the

general scheme was carried out. All students of woodwork were greatly indebted to the author for his very interesting papers read at the Devonshire Association, and for what was even more valuable, his splendid catalogue of the churches with reference to the literature in regard to them, that he gave in his second paper. She was also extremely grateful to the author for the excellent paper he had read.

Mr. BOND, in reply, said that with regard to the origin of the foreign features of the screens, it must be conceded there was great probability that a good deal of the foreign patterns might have been taken from foreign books, or, more probably, from illuminated manuscripts. In all screens in connection with which there were no facts to go by they must take the most probable argument. They knew that such books existed, which would have furnished a sufficiently clear pattern to go by, and therefore they might well have been copied. At the same time he had always felt a lingering doubt, although he should like to believe that English workmen executed the screens. The reason why that seemed to him most probable was that he found on one of the screens, notably the one at Kenton, there were two very different classes of work. First of all, there was the foreign work, which he was sorry to say was very much better executed than the English work by the side of it. It was evidently the work of entirely different individuals, and it seemed to him as if some Fleming or foreigner had been brought over to coach the other workmen and to give them a lead. With regard to the work not being monastic, Mr. Hems was responsible for the saying that at least one of the screens in Devonshire was reported to be the work of the monks of Tavistock, namely, the screen at Abbots Kerswell. He was very glad that Mr. Strange had shown a photograph of the South Pool screen, because he agreed with that gentleman that it was one of the finest specimens; but the same thing was shown at Manaton, which exhibited in a marked degree a similarity to the Celtic treatment. Mr. Strange also stated that the framework of the screens was English. He fully agreed with that remark, the foreign features simply come in in the small details. He was glad to find that Miss Rowe supported his view that the Colebrook screen was French. The screen at Coledridge enclosed a chapel to the memory of Sir John Evans, a knight who fought in the French wars, and there was therefore a suggestion that he might have been in touch with French workmen. He would rather leave the question as to whether the paintings were an aid to ascertain the dates of the screen to an acknowledged master of the subject like Mr. Keyser. The Renaissance work on some of the screens was very possibly filled in; he found in one or two cases it was on a hard plaster on the face of the woodwork. In conclusion he thanked the audience for the kind reception of his paper, and for the support he had received from the various speakers in the discussion.

Mr. PHILIP NEWMAN thought their thanks were due not only to the author for his valuable paper, but also for the additional information which had been contributed to the discussion by the Chairman, Mr. Keyser, Mr. Strange, and others.

The CHAIRMAN said he would like to support one remark Mr. Day had said, namely, that all art was and must be founded on art that had gone before. Mr. Day had mentioned tradition. Tradition was a great principle. People saw something done, and said they could improve on it; that improvement was an advance, and from that they built up the great tradition in art. It came down from the Egyptians through Greece, and by one vast procession, as it were, eventually came to these islands. Nowadays, he was sorry to say, there was too much tendency, especially among the younger members of the profession, to ignore tradition and say they must have something new. That was the destruction of Art. If a young designer or artist produced something new, some people said it was wonderful, and they had never seen anything like it before; but they did not pause to consider whether it was beautiful, graceful, or dignified. Provided it was new it was sufficient for them; but he was sorry to say that the ugliest things were achieved by this "new art."

SIXTEENTH ORDINARY MEETING.

Wednesday, March 29th, 1905; R. C. MUNRO-FERGUSON, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Arnold, W. Hacker, Messrs. H. Whitlock and Co., Holland-gate, Kensington, W.

Gibbons, William Pike, J.P., C.C., Ruiton-house, Upper Gornal, Staffordshire.

Habibullah, Khan Bahadur Md., Vellore, North Arcot District, Madras, India.

Henley, Mrs. A. L., 7, Oxford-square, W.

Jack, Stuart Maclean, 42, Victoria-road, Upper Norwood, S.E.

Jackson, Walter Geoffrey, Prestwick, near Witley, Surrey.

Macdonald, David Baird, F.C.S., 127, Evington-road, Leicester.

Ridley, Frank R., 10, Russell-street, Covent-garden, W.C.

Scholes, William, A.R.C.Sc., F.C.S., 102, Victoria street, Radcliffe, Lancs.

Taylor, Thomas, Rosendale, Newcastle-under-Lyme.

Wilkinson, Henry Ernest, 31, Priory-park-road, Kilburn, N.W.

The following candidates were ballotted for and duly elected members of the Society:—

Carley, Geo. C., 14, Dingwall-road, Croydon.
Cuff, Herbert Mackenzie, E.Ex. A. and C. Telegraph Company, Singapore.
Davies, John Samuel, 9, Clifton-road, Newport, Monmouth.
Dowson, Ernest Alfred, 45, Newhall-street, Birmingham.
Flood, W. H., 1, Northbrook-road, Ilford, Essex.
Parrott, Lieut.-Col. Thomas Samuel, Exploration-buildings, Johannesburg, Transvaal, South Africa.
Prain, Robert P. F., M.Inst.M.M., care of Messrs. Jackson Brothers, Iquique, Chili, South America.
Sabnis, Rao Bahadur Raghunath Vyankaji, Kolhapur, Bombay, India.
Sparks, Hubert Conrad, Suffolk-house, Putney-hill, S.W.
Staver, William H., Casilla 336, Guayaquil, Ecuador, South America.
Thompson, Henry Yates, J.P., F.S.A., 19, Portman-square, W.

The paper read was—

BRITISH WOODLANDS.

By the Right Hon. Sir Herbert Maxwell, Bart., M.P.

I come before you to-night rather in the spirit of a converted criminal than in the hope of telling you anything you don't know already. I hope that my presence here may be taken as evidence of the awakening conscience of land-owners to the opportunities we have missed, to the valuable source of income which we have squandered, and to the urgency for a reform in our system of forestry. I was brought up with an intense and sedulous love of trees; some of my earliest recollections are connected with the instruction given me by my father in what were, at that time, the approved principles of wood management, and I continued to act on those principles after I succeeded to the estate twenty-seven years ago. The result has been that, although I posssess a considerable extent of ground under trees, there is hardly any of it more than fifteen years old, which I should not be ashamed to show to one who understood the principles of forestry as distinct from arboriculture.

I have said thus much as preliminary, in order that too much may not be expected from me in the way of instruction. When Lord Mahon asked the Duke of Wellington whether his experience in his first campaign—that disastrous one in the Netherlands under the Duke of York—had been of any service to him, he replied, "I learnt what I ought *not* to do, and that is always something." Wellington, happily for his country, learnt his lesson while the best part of his life still lay before him. I have learnt mine at a period when Horace's lines have a peculiarly mournful significance—

> "With all the trees that thou hast tended,
> Thy brief concern is almost ended;
> Except the cypress—*that* may wave
> Its tribute o'er thy narrow grave."

Well, now, I have tackled a subject rather unwieldy to be dealt with in an hour's discourse, and I will try to confine myself to a few of the most salient points. I will divide it into two branches—First, what I conceive the State might do, with prudence and profit, to develop the national resources; Second, what private owners might do to develop the resources of their estates.

Since I entered Parliament 25 years ago two inquiries have been directed into this subject; the first, a Select Committee of the House of Commons, which sat 1885-6-7; the second, a departmental committee, which reported in 1902. No action was taken on the report of the first: of the result of the second we have more hopes, because we have now, what we had not in 1885-7, a Government department—the Board of Agriculture and Fisheries—to which has been committed the duty of promoting instruction in forestry. Among the many points upon which both these committees were in thorough agreement were these facts—(1) that "the world is rapidly approaching a shortage, if not an actual dearth, in its supply of coniferous timber, which constitutes between 80 and 90 per cent. of the total British timber imports;" (2) that there is a vast area, estimated in millions of acres, capable of growing timber of the finest quality; (3) that the climate of the British Isles is favourable to economic forestry conducted on a proper scale (not in grudging patches, clumps, and strips); and (4) that it requires only the exercise of timely forethought and a moderate annual expenditure to anticipate the time when scarcity of foreign timber shall have greatly enhanced the price, and to replace with British-grown timber much of those enormous imports upon which we depend at present.

These four points having been emphatically affirmed by the two committees, I need say nothing more upon them to-night; but there is a fifth point on which I venture to go a little further than the departmental committee, "We do not feel justified," says the report, "in urging the Government to embark forthwith upon any general scheme of State forest under present circumstances." Well, I have the teme-

rity, which the committee lacked, to urge strongly the wisdom of embarking upon a scheme of State forestry, and if I am blamed for that temerity, I make the same excuse for my scheme as served a certain young person who had added an unforeseen unit to the population—"Please, sir, it's only a very little one!". I only ask for the investment—the investment, mind, not the gift—of £10,000 a year, for the purchase and planting of suitable land.

No branch of agriculture, not even wheat

FIG. 1.

OAK HIGH WOOD, NEW FOREST.

FIG. 2.

SELF-SOWN OAK, ABOUT 30-40 YEARS OLD (UNDERPLANTED WITH BEECH), AT THORNBURY, GLOUCESTERSHIRE.

growing, has suffered such a slump in the last 25 years as hill sheep-farming. There are hundreds of thousands of acres in Scotland, once valuable sheep pasture, now rented at not more than two shillings an acre. From some of it, a good additional return, say a shilling an acre, is obtained for the grouse on it, but a great deal of it is unsuitable for grouse, but very suitable for growing timber. Such land is constantly being offered for sale. Twenty-five years purchase would secure 1,000 such acres for £2,500. If the ground is level, planting 3 feet by 3 feet will take 4,840,000 trees; the cost at £6 an acre, equals £6,000 for the 1,000 acres. On sloping or steep ground fewer trees will be required and the cost will be proportionately less. I make no provision for houses or fences, assuming that the farm is bought all standing, but £500 must be allowed for repairs and preliminary draining, making a total initial outlay of £9,000 on the 1,000 acres. The interest on the balance of £1,000 ought to pay the annual tool bill, and the annual wage bill may be reckoned at—

	£	s.
Head forester	120	0
Foreman	52	0
Eight woodmen at 18s. a week	374	8
Miscellaneous	103	12
	£650	0

Shall we be able to meet this charge, draw interest on the capital sunk, and hold our capital in hand at the end of 100 years? I think so, even allowing that for the first fifteen years not a farthing of revenue can be drawn from the plantation. By that time the £10,000 sunk will have increased at 3 per cent. compound interest to about £15,000. To secure 3 per cent. upon that sum and to defray the annual expenses of £650, we must show a net annual profit of £1,100 from the 1,000 acres. The returns ought to commence fifteen years after planting, beginning with pit props, for which there is an insatiable demand in this country, chiefly supplied from Norway and Sweden; proceeding to medium sized trees removed in thinning until the period of commercial maturity, which, in the case of Scotch pine and larch, should be reached in 80 or 90 years, when the regular falls will begin. Mr. Nisbet estimates the average annual yield of coniferous timber, Scotch and larch, at 75 cubic feet per acre. Assuming this to be a moderate estimate, and assuming that the price of such timber will not exceed 6d. a foot (an improbably low estimate) your 1,000 acres will be yielding a gross annual income of £1,875, that is, a revenue of 37s. 6d. an acre from land which, as sheep pasture, yielded a rent of 2s. an acre, or £100 from the 1,000 acres. The balance-sheet will show thus:—

Expenditure.		*Receipts.*	
Interest at 3 per cent. on £15,000	£450	Sale of 75 cubic feet per acre at 6d. on 1,000 acres	£1,875
Annual expenses	650		
Balance profit..	750		
	£1,875		£1,875

Supposing that for the next fifty years the State were to invest £10,000 a year in plantations, it would have made a progressive investment of half a million sterling—the cost of four days campaign against the Boers—yielding about 11 per cent. interest, and instead of a rural population of one shepherd to 100 acres of pasture, there would be one woodman to every 1,000 acres, or a total of 500 woodmen on the State forest of 50,000 acres, instead of 50 shepherds. No trifling consideration this in these days of rural depopulation.

There appeared lately in one of the evening papers a letter from a noble earl in reference to Mr. Keir Hardie's proposal for State forestry. His lordship declared that it was futile to think of profitable forestry in the United Kingdom for two reasons—first, because of the furious storms which sweep these islands at irregular intervals; second, because the timber produced in our woods is far inferior in quality to that grown on the Continent.

As to the first objection, I deny emphatically that we are more exposed to storm than, say, Norway or Sweden, whence we draw such large supplies of coniferous timber. It is true that we suffer far more from wind damage than is the case in continental forests, but that is the result partly of our custom of planting in narrow belts and isolated small masses, and partly of the mischievous system of overthinning which came into vogue in the nineteenth century. Trees that have been encouraged to grow heads out of all due proportion to their height will succumb to a storm that may be lifted harmlessly over a solid block of well-grown forest. A thousand *contiguous* acres of woodland will suffer far less from gales than 1,000 acres scattered over an estate of 10,000 acres.

Next, as to the alleged inferiority of British timber to continental. Surely that is a strange allegation against a country that used to supply timber for the noblest fleets that ever

put to sea. I may say in passing that the demand for ship timber had something to do with initiating our vicious system of over-thinning. Shipwrights did not want straight boles, they wanted bent timber; and you will actually find in old treatises on forestry instructions about tying down the limbs of oaks to produce the desired contortion. The result has been that we have conceived and aimed at a false ideal. Our notion of what an oak ought to be is framed upon such a magnificent deformity as the "Major" oak in Sherwood Forest.

That we can grow fine straight oak if we choose may be seen in this example from the New Forest, a domain which, unhappily, the State is not permitted to treat on right principles. Here again is a wood of self-sown oak at Thornbury, in Gloucestershire, 30 to 40 years old, which promises to develop into splendid clean timber. But to obtain examples of the highest development of oak timber, we must go to France. Here are a couple of photographs showing the last stage—the final fall—of a forest of sessile-flowered oaks in a French forest.

Now that we want straight, clean timber, there is no country in the world better able to produce it than our own. Ah but, says the timber merchant, your firs are grown too fast. British deal cannot compare with Scandinavian, which is grown much slower. True, but here again the evil comes from over-thinning. Grow your trees in close forest, and no matter what height they attain or how soon they attain it, the annual rings will be close together, and the timber will be slow grown. It is a mere question of forest management. Trees in open order will produce branches and coarse timber, with wide annual rings; trees grown in close canopy will yield clean planks with narrow annual rings. Here are some examples from a wood of Mr. Elwes's, at Colesborne, in Gloucestershire. Most of these trees measure 125 feet in height, and compare favorably in cleanness of bole with the following examples from Savoy—silver fir with a few spruce, and silver fir, with a larch or two.

It is idle to say that timber cannot be grown at a handsome profit in Great Britain, but it is equally idle to attempt to grow it at a profit unless sound principles of commercial forestry are adopted.

I now come to the other branch of my subject—the condition of woodland on private estates in this country. In dealing with that, I must be understood to generalise. I could name certain estates on which the principles of sound forestry are in full practice, and of which the proceeds of the woods contribute a considerable part of the revenue. But taking one estate with another, I shall not be accused of exaggeration if I describe the woods as run upon amateur lines, more or less modified by local custom. It is not the custom to expect a land agent to have had any training in economic forestry; still less likely is it that the owner himself shall have had such training. It would be natural, then, that neither the agent nor his employer should attempt to interfere with the management of the woods. But what landowner is there so poor in spirit that he does not aspire to direct in person the operations in his woods? He has a forester or woodman, no doubt, with an efficient staff under him, but that forester is very seldom remunerated on a scale calculated to secure sound technical knowledge. On some estates he combines the duties of forester with that of head gardener; on others he receives a salary equal to that of a head gamekeeper. He is at best but a foreman woodman, and even if he pursues sound routine operations these are constantly liable to be interrupted or diverted at the caprice of his employer. It would be strange, indeed, if the result of such a want of system proved anything but disastrous. Imagine any man investing liberal capital in a large farm, without any technical knowledge of farming, or the rotation of crops, and yet dictating to his farm bailiff how and where those crops were to be grown. The result would be apparent in a very few seasons, and, so far as that farm was concerned, the balance-sheet would spell bankruptcy. Even in that case, the amateur farmer would have the example of sound agriculture as practised by his neighbour, and he would have the sense to pick up some knowledge as he went along. But where is the amateur forester to turn for guidance in this country? Perhaps there is not within his county a single example of close canopy and clean timber. And further, whereas the effect of bad farming is manifest in two or three seasons, mistakes in forestry do not become apparent for two or three generations.

I stood not long ago beside the owner of one of the noblest parks in England. He had brought me to see an oak wood, originally pure forest, about 50 acres in extent, which was causing him much concern. They were splendid trees, about 180 or 200 years old, averaging 100 feet in height with 40, 50, 60 feet of glorious clean boles. I don't know

the like of this wood, as it must have been, if it be not the forest of Cour Chevernay on the Loire opposite Blois. Twenty years ago there cannot have been less than 9,000 or 10,000 cubic feet per acre, which, taken at only 1s. a foot, represents a value on the 50 acres of some £25,000, or £500 an acre. Who could have blamed the owner had he treated this woodland as a crop? Well, all his neighbours would have blamed him bitterly, so deeply rooted has become our habit of looking upon woodland merely as an extra—a luxury—a playground. And yet I maintain that it was folly not to turn this timber to account. For

FIG. 3.

LARCH, BEECH, AND SPRUCE AT COLESBORNE, GLOUCESTERSHIRE.

look you what has happened. My friend had all the amateur love of trees which is so characteristic of English country gentlemen. About twenty years ago, thinking to improve the landscape, he had glades cut in this noble grove, and thinned out the whole of it severely. His forester, if he knew his business, may have warned him what must happen if pure oak high wood is suddenly converted into trees in open order. If he did so, his advice was disregarded; the owner knew what he wanted, but the result has been far different. Nearly every tree has become stagheaded and thrown out an eruption of growth all along the

FIG. 4.

LARCH, BEECH, AND SPRUCE AT COLESBORNE, GLOUCESTERSHIRE.

stems and branches. The grove has been ruined.

My friend did me the honour to ask my opinion. If I had given it, he would have called me a beggarly Scot, so I held my peace, even from good words. But I had no doubt what a wise forester's advice would be—fell all the remaining trees and replant. As near as I could judge, there seemed to be an average of thirty oaks left on every acre. These cannot be worth less than £7 10s. apiece standing, or an aggregate of £11,300 on the 50 acres. I have purpose'y put this calculation very low, for I was shown where one of these oaks had been felled recently, and the timber sold for £20. But I know what will happen. My friend loves his trees; he will never harden his heart to part with them; they will go from bad to worse, and the greater part of this money will be sacrificed. The future of these noble trees will be like that of the mournful ruins in Cadzow Forest, Lanarkshire.

Now one must take things as one finds them, even if one may entertain a hope that better understanding may prevail some day. The British landowner has a perfect right to manage his woods in the way best calculated to secure the objects he has in view. These objects, I think, are generally as follows :—

1st. Landscape effect, especially park scenery.

2nd. Game cover.

3rd. Shelter.

4th. Timber for estate purposes.

To insist upon the uniform application of strict continental sytem to all classes of land in this country is very far from what I advocate. In the first place, I don't think close canopy is as essential on a great part of our area as it is on dry soils and climate. The climate and soil of our islands, part of them, at least, is far more propitious to tree growth than those of a great deal of the forest area of Europe. But what I do advocate is the application of strict system, modified to suit our peculiar circumstances.

Now let us take these four objects which I have mentioned as uppermost in the average landowner's purpose, and see how far they are to be reconciled with a sound system of forestry.

1. *Landscape effect, especially park scenery.* He must be callous indeed, be he landowner or simple wayfarer, who is indifferent to the charm of English park scenery, which consists of prairie with groves and scattered trees. But it is an effect which can only be obtained as the result of age. The finest park scenery is a gradual evolution from close forest, and never can be attained by planting single trees apart upon a plain. By that means, you obtain nothing but huge cabbages with an ugly horizontal browzing line, or picturesque monstrosities such as the great beech at Kilkerran, Ayrshire, which girths 19 ft. 6 in. at 5 ft. high, or malformed specimens like this ash. Now compare with such results some park effects that have been evolved out of high forest.

Trees are social creatures; for the development of their true character they require the discipline of close company to rear stately stems and preserve symmetrical heads. I must not linger over long upon this fascinating subject, but if anyone doubts my contention that good forestry is not only reconcileable with the finest park scenery, but is actually essential to its production, let him visit Ashridge-park, within 30 miles of this room, and reflect upon the process which reared the famous beeches there.

It is out of a well-grown woodland only that you can carve a beautiful park. For the last 60 or 70 years most of us have been doing our best to render growing woods incapable of producing fine park scenery. We have been taught to thin mercilessly—to allow no tree to interfere with another, thereby preventing the development of clean stems, and encouraging instead a wild profusion of branches, as if the object had been to produce an orchard.

Well, but it is argued, a regular forest, grown on Continental principles, is painfully monotonous. You will lose all the variety and life of an English park if you insist upon close canopy. My answer is that of all rural industries forestry, in its ordinary operations, is productive of the most picturesque scenes.

There is another and more pressing aspect of park management. British landowners are far less affluent they were thirty, fifty, and one hundred years ago. It is a question with many of them whether they can maintain their parks at all. Is it not sheer blindness to refuse to develop what may be rendered not only a source of regular income but a reserve to be drawn upon in times of special pressure, such as the payment of death duties. Why, so far from destroying English park scenery, the application of science and system to wood management may be the very means of saving many a park from the hammer or the speculative builder.

Before it can be hoped that landowners will

take that course, they must apply themselves vigorously to acquire the principles of the craft, unlearn a great deal that they have been taught, and harden their hearts to deal with their woods in general as a crop.

2. *Game Cover*.—This is perhaps the point at which British landowners and foresters are most directly at issue, and I admit that it is not easy to reconcile the idea of an English game cover with economic forestry, seeing that underwood has ceased to have any commercial value. At the same time it is a fact that our present system of battue came from Germany, where forests are managed on the strictest principles of commerce. Close high wood is disliked by game, chiefly because of the scarcity of food there; but cover shooting is such an artificial affair now that pheasants may be made to haunt whatever ground is best adapted for their artistic destruction. It is merely a question of where their food is provided. As for cover, there is no cover better than young wood up to 15 or 20 years, and in a woodland, managed on economic principles, there will always be a due proportion of young wood, into which birds may be driven for the rise.

But there is one form of game absolutely incompatible, not only with profitable, but with decent forestry. Will any landowner, honestly and boldly, calculate what ground game, especially rabbits, cost him per acre of plantation. Every yard of ground that is planted must be wire netted, and this cannot be done at less than 6d. a yard. Where the woodland is worked in proper annual rotation, ten acres, say, filled every year, and ten acres replanted, the cost of wire netting is at a minimum, for a square of ten acres may be fenced for between £20 and £30—say an additional cost of 50s. an acre. A pretty heavy inroad upon capital expenditure; but you must multiply this indefinitely if you wish to deal with blocks of less than ten acres—if you wish, for instance,

FIG. 5.

DENNY ENCLOSURE, NEW FOREST, SHOWING NATURAL REGENERATION INSIDE FENCE.

to plant up blanks in woodland from half an acre to two or three acres in extent. And even this is not all. Where the detestable rabbit abounds, ground cleared of timber cannot be restored by natural regeneration. In such a case, there must be placed to the debit of the rabbit account, not only 50s. an acre, the cost of wire netting, but £6 an acre, the cost of replanting which would be unnecessary on ground suitable for natural regeneration. In other words, the presence of rabbits means an initial tax upon young forest of £8 10s. an acre, which may be equal to half the fee of the land. If British forestry is ever to regain the place to which our soil, climate and requirements entitle it, it must be relieved from the intolerable scourge of rabbits. The place for the rabbit, and the only place, is the warren. In those scenes I showed on the screen from Ashridge-park, you may have noticed how bare was the ground, not only under, but around the beech trees. To show what that ground is capable of doing in the way of natural regeneration, look at this part of it which has been protected from rabbits and deer for the last 15 or 20 years.

3. *Shelter.*—Shelter from sea blasts or from the prevailing wind is a most legitimate object in forming a plantation. I have only a few words to say about it. Do not grudge a few acres in laying out belts. Even a narrow strip affords warmth and shelter so long as it is young, but there are few things more cheerless than the same strip when the trees are approaching maturity, and the wind blows draughtily through it. The most successful sea shelter which I have seen is on Lord Leicester's estate at Holkham, where miles of sand dunes have been planted with four different species of conifer, Scots pine, pinaster, Austrian and Corsican; and the Corsican has beaten all the others in a very remarkable manner. It even reproduces itself, although there is much ground game about.

4. *Timber for Estate Purposes.*—A most important object this, and one that is usually accomplished, but at what cost! I do not hesitate to say that on many estates if the rent of the ground, annual rates, cost of planting and wage bill be reckoned, much money would be saved if not a foot of home wood were used, and foreign supplies bought from the timber merchant. And yet you say that timber ought to be grown for the market at a profit! Certainly it ought, but not on the present system, not unless timber is treated as a crop with a regular fall and grown of good quality. It is the cut-and-come-again method that is ruinous both in cost and in quality. The annual fall ought to supply both estate purposes and the timber market. Yet I have heard within the last few months landowners complaining that they cannot get an offer even for fine timber. No, because they have not secured a proper business connection. To do that two things are necessary, as any greengrocer will tell you, regularity of supply and uniformity of quality. It is estimated that there are 3,000,000 acres of woodland of sorts in Great Britain and Ireland. In Belgium there are only 1,750,000 acres yielding a return of £4,000,000 a year. At that rate British woodlands ought to yield £70,000,000 a year. At what figure would the most liberal estimate fix the return? Yet British timber properly grown would be no whit inferior to Belgian.

The fact is there is no regular trade in home timber. Merchants cannot rely upon a steady home supply so they have recourse to countries where they can be sure of getting exactly the quantity and quality they require. Mr. Nisbet has put the case concisely.

"Available markets cannot be utilised to the best advantage if the quantity of wood offered one year is large, the next small, a third year wanting altogether, and so on irregularly. 'First a hunger, then a burst,' is bad in this as in all other cases." Add to this, that woodland subject to inordinate thinning—to arboriculture instead of forestry—produce timber of such inferior quality as to lead architects to stipulate for foreign timber in all their work.

Now I think I have said enough to explain the general character of what is on my mind in this matter. To go closer into details would outrun reasonable limits of time. I am convinced that by adopting sounder principles and continuity of treatment, both the State and private owners of land might indefinitely enrich future generations, and indemnify themselves meanwhile, wholly or in part, for the outlay and lock-up of capital by clearing the ground of a great deal of ill-grown wood which occupies it just now.

One circumstance is highly favourable to reform. There is plenty of sound instruction in sylviculture to be had. Five and twenty years ago British landowners could only turn to such vicious and misleading instructors as Brown and Michie. Now there is abundance of good literature, and such writers as Schlich, Nisbet, and Forbes are at hand to pilot enquirers into the true course.

DISCUSSION.

The SECRETARY read the following letter from Dr. Schlich:—

It is a great disappointment to me that I am unable to hear Sir Herbert Maxwell read his important paper on "British Woodlands," this evening, but as you have been good enough to send me an advanced copy, you will, I trust, allow me to offer a few remarks on it. Until now most British landowners have hesitated to admit that economic sylviculture can be applied to their woodlands, maintaining that the latter are a thing apart, and now Sir Herbert Maxwell comes forward to denounce publicly his former opinions, and to urge the application of rational sylviculture, and above all systematic and sustained treatment, in the case not only of our ordinary woodlands, but even in that of parks and other ornamental woods. By doing this, Sir Herbert Maxwell has rendered a greater service to the development of rational forestry in this country than he is probably himself aware. But he has done even more than that, inasmuch as he calls upon the Government to devote the exceedingly modest sum of £10,000 a year to the acquisition and afforestation of waste lands, thus creating object-lessons which cannot fail to have the most beneficial effect upon the further extension of our woodlands. He tells us that hundreds of thousands of acres of mountain land fit for planting can be acquired at the rate of £2 10s. an acre, representing 25 years purchase of the present rent derived from sheep grazing, and he calculates that a return of considerably more than 5 per cent. on the invested capital can be secured. Let us hope that those in power will read what Sir Herbert Maxwell says and act accordingly! Great efforts are now being made in Britain, to provide theoretical instruction in forestry, at quite a number of educational establishments. This pleases many people who take an interest in the matter, but it is only part of the business. All this theoretical instruction will, as it were, be of comparatively small value unless we provide at the same time the means of practical instruction. For this purpose we require systematically-managed woodlands, which are found few and far between in these islands. The Commissioners of Woods have of late years made a gallant effort to manage the Crown forests on rational lines and according to well-arranged plans; but what we require over and above this is that the State (or, in some cases, corporations) should acquire areas of mountain and heath lands in various parts of the country, plant them up, and manage them rationally, so that they may serve as examples to the surrounding private proprietors and to the student of forestry. Even if, as Sir Herbert Maxwell suggests, only £10,000 a year were appropriated for the purpose, some substantial good could be done in England, Wales, and Scotland. As to Ireland, the splendid opportunity which the administration of the latest Irish Land Act offers of acquiring and planting surplus areas in the case of estates which are broken up for sale to the tenants, should certainly not be missed. I hear sad accounts from Ireland as to the great destruction of the remaining woodlands by the new proprietors, and it seems to me to be the direct duty of the State to make good, at any rate, the mischief which the Land Act is working in this respect. The woodlands belonging to the State, or the Crown, whether already existing, or to be planted, should serve another very important object, namely, the collection of correct statistics, showing the yield, the receipts and expenses connected with woodlands, managed on economic lines. At the present time, there are hardly any areas in this country which could serve for the above purpose As long as we have no tables giving the probable increment and yield of our woodlands, we are groping in the dark as to the financial results of the forest industry. To sum up, I must once more thank Sir Herbert Maxwell for the great service which he has rendered to-day to a cause in the interests of which I have struggled against adverse conditions during the last twenty years.

The CHAIRMAN thought that those who had given attention to sylviculture would be the first to admit that the opinions expressed by the author were, as might have been expected, perfectly orthodox. He did not think one could have had a more admirable precept as to the opportunities and duties of private landowners and the State, whose duty was a very considerable one, than that given in the paper. The author had referred to the question of instruction in sylviculture. There were no doubt better books ready to hand in the present day than their fathers had, but at the same time the study of sylviculture was very largely a matter of object-lessons. English people were very empirical in their habits, and foresters were especially so. Without viewing the woods, the museums, the collections, and all the different object-lessons which were so perfectly established in other civilised States, he was not very hopeful of any large departure in the private or public management of woodlands. The author had referred to the shortcomings of the Report of the Departmental Committee. He admitted that the recommendations of the Report were not adequate to the requirements of the country, but he thought the recommendations went as far as they were likely to get any Government to go, and as far as they were justified in asking any Government to go, because one was not justified in undertaking any great creation of sylviculture in this country without having men properly trained to undertake it. Apart from a few Indian Forest officers and others whom one could count almost upon the fingers of one hand, there were none who were competent of expressing an opinion as to how sylviculture should be conducted in Britain. Indeed, without the object-lessons, he doubted whether the best of the experts could

say what ought to be done. Some of the best foresters in Germany and France had very truly pointed out that there was probably no country in the world where some of the most valuable American coniferæ could be better grown than in parts of Britain, but they were not yet grown upon sylvicultural principles. English people had barely begun to plant them properly, and it must be some time before it was possible to judge how far those anticipations would be fulfilled. He believed the first requirement which had to be met, was the adequate provision, by experimental areas and forest schools, for the training of men competent to manage woodlands. The author's proposal of setting aside £10,000 a year was, he thought, a very moderate one. It was undoubtedly necessary, by some grant of that kind, to make provision for giving sylviculture, either by the State or by the individual owner, a fair chance. The author had divided modern forestry into three parts,—ornamental forestry, economic sylviculture for profit, and objects such as the amelioration of climate, the prevention of erosion, or the storage of water, which could be attained by plantations under certain conditions. He believed England had no rivals in the world in regard to ornamental afforesting, such as pinetums, parks, and pleasure grounds, but sylviculture was practically unknown except in very limited areas; and the ornamental forests themselves were limited, because, yielding no profit, the areas under timber were necessarily limited by the resources of the owner. England could not do better than maintain the advantage she possessed in ornamental plantations, and could not too soon make provision for enabling landowners to have profitable sylviculture, to store water, to prevent erosion, and obtain the other advantages which were incidental to proper sylvicultural treatment of the land. England imported nearly thirty million pounds worth of timber a year, twenty-five of which could be profitably grown at home; and it was about time some system was adopted, which had a fair chance of success, of giving foresters adequate training to enable them to deal intelligently with the work that lay before them.

Sir DIETRICH BRANDIS, K.C.I.E., said the great truth that trees in order to yield valuable timber must grow in thick masses where they drew each other up to the greatest height an individual tree could attain, and where, at the same time, their close contact prevented the formation of branches, which was the chief thing to teach those who managed woodlands in this country, had been admirably stated by the author. Another point which had been equally well set forth was that certain trees required a mixture with other trees in order to thrive. If the oak trees in the Forest of Dean had been grown in company either with beech or silver fir, they would have presented quite a different appearance from their present miserable state. In 1865, on his first furlough home from India, with the enthusiasm of a young man, he visited a great many of the woodlands in England and Scotland, including some of the finest coppice woods of ash and sweet chesnut which he had ever seen in his life. The owner told him that he had used the best wheat land, and raised very strong seedlings, managed the land under a rotation of seven years, and produced hop-poles which were in large demand in those days, the land thus yielding him £5 an acre net. It was very difficult not only in England but in other countries to obtain the financial results of the forest management of private estates, and that was one of the chief reasons why States and private individuals did not take the question up. The communal forests in Germany were the staple of the wealth of the country, and the Crown forests of this country might be made extremely valuable as object-lessons of rational forestry if they were properly managed. The plan which the author had foreshadowed would do an immense deal towards making people familiar with the idea that the planting up of waste lands was profitable. The timber merchants in Saxony, Bavaria, and other parts of Germany were able to make their plans in advance because they knew every year that each forest range was expected to yield a certain quantity of timber of a certain kind, while in England there was no regular yield which enabled the timber merchant to frame his plans, and consequently he found it more convenient to make arrangements for buying the timber at the port where it arrived from abroad. It was interesting in connection with rabbits, to state that in Richmond-park young oaks were now coming up under the oaks which were standing very far apart. This would have been impossible when millions of rabbits were allowed there.

Mr. H. J. ELWES said that no doubt the principles which the author had so well laid down were very sound, but there was another point of view which he did not think he had sufficiently touched upon, namely, the feeling amongst almost all landowners who were able to live upon their estates that not only from an ornamental but a family point of view, a man who tried to manage his trees properly was looked upon as a wretch who was doing the worst he possibly could for his estate. A great many landowners did not realise the enormous sums they lost annually in interest through allowing timber to stand long after it was mature; but at the same time, if they could afford to do so, it seemed to him that not only the landowners but their relations and the country generally derived from the old English system of treating trees an amount of pleasure that could hardly be over-rated. People did not realise the enormous indebtedness they were under to the owners of those trees for allowing them to stand long after they ought to have been cut down, and the feeling was so strong that he did not believe any amount of teaching would alter it. He thought English sylviculturists were under a debt to German foresters for

having emphasised in a more pointed way than had been done by English writers the essential fact that without some nurse, of which beech was by far the best, fine big timber could not be grown on poor land. He was not one of those who admitted that waste land could be planted with profit. In a great many districts half of the expenditure thus involved would be a dead loss. Local knowledge and experience in such matters were of even more importance than teaching. There was no mistake so great as to imagine that a person after having learned the principles of forestry, could apply them in any part of England without local knowledge and observation, and experienced foresters had made extraordinary mistakes by giving advice in districts where they did not know the whole of the conditions. If a man had a desire to plant his waste land, he firmly believed that in many cases it would be a better investment to plant it from an ornamental and sporting point of view than from a timber point of view; because he had seen gigantic failures not only in State forests, but in private woods through planting trees on land where they would not grow except to a scrubby imperfect state. In looking through the evidence given before the Commission on Agriculture in 1886, in which long lists of accounts in connection with woodlands were given, he did not find one single argument which would justify a man in saying that planting waste land was really a good investment at the present time; and although he had himself for many years past been planting very largely, he had come to the conclusion that it was very much in the nature of a gambling transaction. Nevertheless, woods and plantations were a source of continual pleasure, which grew with age, and therefore planting was a thing to be encouraged by every possible means. But before advising the State or private landowners to embark very largely in what must be, to a great extent, a rather uncertain future, one ought to emphasise the importance first of all of getting some reasonable reduction in the taxation on growing timber; secondly, of getting some reasonable protection to English investors for the benefit of the country much more than themselves—that they should not have the whole of their profits wiped out by unlimited foreign competition; and, thirdly, by giving such education in forestry as would enable landowners to obtain a forester who was not too fine a gentleman to work with his own hands, and, at the same time, had something more than the mere local knowledge which the average country woodman had.

Professor W. R. FISHER thought the point ought to be mentioned in connection with the management of the Crown forests, that they had never had a fair chance, because, instead of all ages of the trees being represented in them, they were nearly all planted at the same time. The result was, that it was impossible to get a steady revenue from them, as a large sum of money was spent, perhaps, eighty years ago, and the woods were still too young to be felled. The book-keeping was also of a extremely miscellaneous character. Instead of the woods being kept entirely separate from other parts of the accounts, they were mixed up with the game and buildings, and cleaning gravel paths, which made it impossible to show what the woods really did produce. He thought it would be of very great benefit if the Crown forests were put in the hands of one man instead of two. At present there were two Commissioners of Woods and Forests, neither of whom had complete charge of the woods. He believed there were forty square miles of oak forests in the Crown land, and there was not the slightest reason why those woods should not be as good as those in Normandy. As the Crown woodlands were probably the only lands in the country where fine oak was likely to be grown, he thought the Government should take the matter in hand by putting the woods under one authority and having a separate system of accounts, although a statement of the expenditure and revenue was no measure whatever of the excellent work that was being done by Mr. Stafford Howard in the Crown woodlands at the present moment.

Mr. ALEXANDER HOWARD quoted figures which showed the decrease in the size of the timber which had been sent to this country from the Baltic in the last 25 years, and which also went to prove that the sources of supply had entirely changed. It consequently appeared to him that the author's suggestion that there was a great future before home-grown timber was likely to be correct. He thoroughly agreed with the author that there must be a steady and organised system of supply, otherwise it would be quite impossible to make reckonings or to get timber merchants interested in the subject. Another source of difficulty was the taxation of the country, it having been estimated by a friend of his that English people paid £1,000 in rates in England for every £100 that was paid in other countries. The railway rates and other expenses of delivery in this country were also absolutely impossible. Timber could be brought 2,000 miles from the interior of another continent, across an enormous ocean and brought into England for less than English timber could be brought from a town 100 miles from London to London itself. Until railway rates were brought within the compass of the price for which timber could be charged, it was impossible for English landowners to compete with foreigners. The quality of the timber was also most important. More enthusiasm must be displayed by English landowners before British timber would be able to compete with the much cleaner and better grown qualities which were imported from abroad.

On the motion of the CHAIRMAN, a very hearty vote of thanks was accorded to Sir Herbert Maxwell for his interesting paper.

Sir HERBERT MAXWELL, in reply to Mr. Elwes's remark in regard to the inferior quality of some English land, said that however far certain portions of the surface of Great Britain had departed from the forest condition, there was very little doubt that practically the whole of the British Isles were once under forest except the extreme tops of the hills; and in order to restore that forest it was necessary to restore the forest conditions - a very difficult operation. He hoped he had not been understood to throw any reflection upon the administration of His Majesty's Office of Woods. Most people were aware of the great difficulties under which that office laboured, including the perpetual interference of Parliament with the proper administration of such a magnificent estate as the 64,000 acres of the New Forest. He had every sympathy with the administration, and had merely mentioned the balance-sheet in support of his contention that it was in vain under present conditions for any private landowner to look to the State for an example in sound forestry. He had mentioned in the paper the inadequate remuneration of foresters in general. Foresters worked for a wage which did not justify their employer expecting them to display more than mere ordinary knowledge of routine. A landowner with a moderate extent of woodlands could very seldom afford to pay his forester more than the current rate of wages, especially if the loss upon his woodlands was as serious as it usually was. Would it not be possible for landowners in the same county or the same neighbourhood to co-operate and employ one competent man to act as head forester on half a dozen different estates? He thought that suggestion was worthy of consideration, because it was obvious that in order to have proper woodlands it was necessary to have a man of very superior capacity.

COTTON MILLS IN CHINA.

The China Mission of the Blackburn Chamber of Commerce, which visited Shanghai when cotton mills under foreign management were in their infancy, gave it as their opinion that while the new mills could not be considered as directly competing with the productions of the United Kingdom, the surrounding circumstances and conditions were so favourable to the expanson of trade that Lancashire must eventually suffer serious indirect loss. But it cannot be said that as yet cotton mills in China have done much to fulfil this expectation. The spinning of cotton into yarn, and the weaving of yarn into cloth, are industries which have existed in China for a thousand years, but it was not until 1895, when the Treaty of Shimonosaki gave freedom to foreigners to engage in all kinds of manufacturing industries in the open ports of China, and permitted them to import machinery for that purpose, that mills for treating raw cotton by means of steam-driven machinery began to be erected. No less than eleven mills, Chinese and foreign, were then taken in hand, but since then expansion has been unexpectedly slow. In his report just issued (Cd. 2237) Mr. J. W. Jamieson, the British Commercial *Attaché* in China, gives a list of seventeen mills in China and Hong Kong spinning yarn, or weaving cloth by means of team-driven machinery, and none of them seem to be doing well. Four of them represent half a million of European capital sunk. It was assumed that with the aid of cheap labour, skilled management, and abundant supplies of good cotton, a handsome profit would be earned, but one of these companies has had to write down its capital 50 per cent., and dividends are still wanting.

The main feature which has operated against the Chinese mills has been their failure to obtain supplies of raw cotton at reasonable prices and in good condition. It was assumed at the outset that cotton would never go beyond 11·50 taels per picul, as for years its price has remained stationary at 11 taels. But there are rings and combinations in China as elsewhere, and the Chinese middlemen have gradually forced up prices until now cotton has to be bought at 90 per cent. over the figure on which the original calculations were based. The fall in the price of silver has, of course, materially contributed to this rise, there being a difference of 24 per cent. between the figures of 1896 and 1903. The mills have to contend, too, with the practice of adulterating cotton with water. It has been attempted to stamp out this evil with the aid of official support, but just as Chinese officialdom in the past neglected to protect vital commercial interests centering in tea and silk, so now it is unlikely that it will take any efficient steps to protect the cotton industry. Much might be done by extending areas of cultivation, improving the quality of the fibre, giving care to the selection of seeds and the use of fertilisers, and freeing the industry from the incidence of vexatious imports and petty interference, but Chinese officials are not likely to change their time-honoured attitude of regarding industrial development simply as an additional means of extracting revenue. Chinese labour is said to be becoming more efficient year by year, and it is certainly cheap. The working day lasts 13½ hours, night shifts working 10 hours extra. Many mills in Shanghai pay by "piece-work," and the average amount earned is about 6d. a day; but cheap labour is only one of the conditions of success in the cotton manufacturing industry as in others, and a good deal will have to be changed before the mills of Shanghai give a fair return upon the capital invested in them.

RED SEA PEARLS.

The Red Sea pearl fisheries at Lohia is an industry about which very little appears to be be known. The name Lohia applies to a small group of islands at the lower end of the Red Sea, and pearl fishing has been carried on there for a number of years. The divers

are all Arabs, but the men who finance the industry are generally natives of India, and for this reason it is hard to get an idea of the exact output in number of pearls, or their value, for any particular year, as a good number of pearls found at Lohia go direct to Bombay, and are not reported at Aden at all. The trade returns for 1903 show that there were exported from Aden pearls to the value of £15,400, but this, it is said, is by no means the total output of the Lohia pearl fisheries for that year. There are several merchants at Aden who deal in these pearls. Each pearl or collection of pearls is sold according to the particular perfection of the pearl or collection, and there can be no price given for pearls indiscriminately. Several years ago there was a considerable trade with the United States in mother-of-pearl shells from the pearl fisheries, but the entire output now goes to Europe. Pearls are the most popular of all the precious stones among the inhabitants of India and Arabia, and it is very seldom that a native woman of any social position is seen without pearl ornaments of some kind either in rings for the nose, ears, or fingers, and some even wear pearl rings on their toes. Owing to the fact that pearls are so popular as an ornament with these people, and to their almost universal use in and about Aden, the local demand almost entirely absorbs the output of the pearl fisheries in that part of the world, and very sew pearls secured in those districts find their way to European or American markets. In the Persian Gulf there are extensive pearl fisheries, the entire output going to Bombay.

GENERAL NOTES.

Wireless Telegraphy in the Andamans.—Sir Richard Temple, in his paper "Round about the Andamans and Nicobars," read before the Indian Section of the Society in December, 1899, strongly urged the installation of wireless telegraphy at Port Blair, in order to place the Andaman Islands in direct communication with India. In a recent number of *Nature* the fulfilment of Sir Richard's desire is announced. The experiments, according to the *Pioneer Mail*, give most satisfactory results. A recent message transmitted from Port Blair reached Calcutta in nineteen minutes, though it had come over the land-lines after being received at Diamond Island.

Agricultural Education and Forestry Exhibition, 1905.—A forestry department will be organised in connection with the forthcoming show of the Royal Agricultural Society of England, to be held at Park Royal from the 27th to 30th June next. The exhibition will follow generally upon the lines of that of last year, and the co-operation of owners of forests and woodlands, their foresters, and others interested, are invited to assist by sending suitable exhibits to illustrate the various branches of British forestry. Copies of an entry form, with detailed conditions, can be obtained on application to the Secretary, Royal Agricultural Society of England, 13, Hanover-square, W.

German Trade in Morocco.—In view of the visit of the German Emperor to Tangier, and what is being said in Germany about the commercial interests of Germany in Morocco, it may be interesting to note the figures of German trade in Morocco as given in the latest official returns. Cheap freights on German lines, and cheap handling at the German ports of discharge, are gradually improving the German position, but Germany is still fourth on the list, both as to exports and imports. In 1903, Great Britain had 34½ per cent. of the export trade of Tangier, Germany only 2¼; Great Britain 47 per cent. of the import trade, Germany only 4½. The value of the export trade to the United Kingdom was £132,706; to France, £49,968; to Germany, £8,000. Of the import trade the figures stood respectively for the three countries at £206,246, £120,098, and £37,345. So with Laraich. The export trade with the United Kingdom was valued at £28,667, with France at £13,926, with Germany at only £2,597. It was the same with the imports. From the United Kingdom they were valued at £388,713; from France at £257,068; from Germany at only £22,234. With Tetuan, Germany seems to have ceased doing business. In shipping, the German position is better, the German tonnage entering Tangier being exceeded only by the British and Spanish; at Laraich it is exceeded only by the British and French. Assuming some improvement in German trade with Morocco since these returns were made up, they suffice to show that German trade with Morocco is not of great importance.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock:—

April 5.—"Ancient Architecture of the Great Zimbabwe." By Richard N. Hall.

April 12.—"The Industrial Resources of the State of Matto Grosso, Brazil." By George Torrance Milne, F.R.G.S. Colonel George Earl Church will preside.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

April 6.—"The Prospects of the Shan States." By Sir J. George Scott, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States. The Most Hon. the Marquis of Bath, will preside.

Colonial Section.

Tuesday afternoons at 4.30 o'clock:—

May 23.—"The Cape to Cairo Railway." By Sir Charles H. T. Metcalfe, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MAY 2, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S I., will preside. This meeting has unavoidably been postponed from April 11, as previously announced.

MAY 16, 4.30 p.m.—"Popular Jewelry." By MONSIEUR RENE LALIQUE (Paris). ARTHUR LASENBY LIBERTY, J.P., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

HERBERT LAWS WEBB, "Telephony." Four Lectures.

LECTURE IV.—APRIL 3.—*Development and Tariffs.*—Supremacy of telephonic communication—Essential features of modern telephone service—Organisation of telephone plant and business—Evolution of telephone rates—Scientific telephone tariff—Effect of area on cost—Varying demands of consumers—Graded classes of service—Telephone development in different countries—Long distance service and rates.

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures. May 1, 8.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures. May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 3... SOCIETY OF ARTS, John-street, Adelphi, W C., 8 p.m. (Cantor Lecture.) Mr. Herbert Laws Webb, "Telephony." (Lecture IV.)

Farmers' Club, Whitehall-court, S.W., 4 p.m. Rev H. H. Slater, "Wild Birds."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. W. Pollard Digby, "Statistics of British and American Rolling Stock."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Messrs. C. Napier Hake and R. J. Lewis, "The Formation of Sulphuric Esters in the Nitration of Cellulose and thei influence on stability." 2. Mr. H. W. Brownsdon, "The proof of Percussion Caps."

British Architects, 9, Conduit-street, W., 8 p.m. Prof. Beresford Pite and Mr. J. W. Simpson' "The Planning of Cities and Public Places."

Camera Club, Charing-cross-road, W.C , 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. J. M. Peebles, "Essay on Immortality."

TUESDAY, APRIL 4...Royal Institution, Albemarle-street, W., 5 p.m. Mr. Perceval Landon, "Tibet." (Lecture I.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Alpine Club, 23, Savile-row, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by Mr. C. S. R. Palmer. "Coolgardie Water Supply."

Pathological, 20, Hanover-square, W., 8½ p.m

Faraday Society, 92, Victoria-street, S.W., 8 p m, 1. Mr. A. H. Hiorns, "Alloys of Copper and Antimony and Copper and Bismuth" (illustrated). 2. Mr. E. Kilburn Scott, "Refractory Materials for Furnace Linings" (Discussion). 3. Messrs. S. Hutton and W. H. Patterson, 'Electrically Heated Carbon Tube Furnaces" (Part I.)

WEDNESDAY, APRIL 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Richard N. Hall, "Ancient Architecture of the Great Zimbabwe."

Geological, Burlington-house, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Paper on "Somerset Church Towers: their characteristics and classification."

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, APRIL 6. .SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p m. (Indian Section.) Sir J. George Scott, K.C.I.E. ("Shway Yoe"), "The Prospects of the Shan States."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Prof. R. J. Harvey Gibson, "Intraaxillary Scales of Aquatic Monocdyledons." 2. Mrs. Veley, "A Further Communication on the Study of *Pelomyxa palustris.*"

Chemical, Burlington-house, W., 8 p.m. Papers will be read by Mr. McIntosh, Mr. R. N. V. Sidgwick, Mr. A. Slator, Mr. C. E. Fawsitt, Messrs. A. E. Dixon and J. Hawthorne, Mr. J. Y. Buchanan, Mr. S. Ruhemann, Mr. M. O. Forster and Miss H. M. Judd, Mr. H. A. D. Jowett, Mr. J. T. Nance, Messrs. H. Jackson and D. N. Laurie, Mr. F. S. Kipping, and Messrs. F. S. Kipping and A. E. Hunter.

United Service Institution, Whitehall, S.W., 3 p.m. Mr. Douglas Owen, "Maritime Warfare: Modern Conditiens and the Ancient 'Prize Laws.'"

Royal Institution, Albemarle-street, W., 5 p.m. Prof. R. Meldola, "Synthetic Chemistry" (Experimental). (Lecture I.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on (1) "The Report on the International Congress at St. Louis," by Mr. W. Duddell. 2. The Papers on "Systems of Electric Units," by Prof. Ascoli, Prof. G. Giorgi, Professors H. S. Carhart and G. W. Patterson, and Dr. F. A. Wolff.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, APRIL 7...Royal Institution, Albemarle-street, W., 9 p.m. Mr. Alfred Moreley, "American Industry."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. R. G. Clark, "Cofferdams for Dock Use." 2. Mr. J. R. Fox, "Bath Corporation Waterworks Extension."

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Lecture by Mr. H. Phillips Fletcher.

Geologists' Association, University College, W.C., 8 p.m.

Junior Institution of Engineers, Westminster Palace Hotel, S.W., 8 p.m. Mr. George H. Hughes, "Practical Notes on Water Works Construction."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, APRIL 8...Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Some Controverted Questions Optics." (Lecture II.)

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FRIDAY, APRIL 7, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, APRIL 12, 8 p.m. (Ordinary Meeting.) GEORGE TORRANCE MILNE, "The Industrial Resources of the State of Matto Grosso, Brazil."

The meeting of the Applied Art Section, previously announced for Tuesday, April 11th, has been postponed to May 2nd, when Mr. J. STARKIE GARDNER will read a paper on "The Monumental Treatment of Bronze."

CANTOR LECTURES.

Mr. H. L. WEBB delivered on Monday evening, 3rd inst., the fourth and last lecture of his Course on "Telephony."

A vote of thanks to the lecturer for his valuable course of lectures was passed, on the motion of the Chairman.

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, April 6th; THE MOST HON. THE MARQUIS OF BATH in the chair.

The paper read was "The Prospects of the Shan States," by SIR GEORGE SCOTT, K.C.I.E.

The paper and report of the discussion will be published in a future number of the *Journal*.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, March 16th; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The CHAIRMAN, in opening the meeting, said it would add to the pleasure of those present if he left it to Mr. Hodson to introduce himself to his audience by the delivery of his paper. He had had the privilege of reading it beforehand, and he could confidently say that they would soon find that Mr. Hodson was complete master of his subject. And he was more than that. There were many passages in his paper that would probe them to the quick, all expressed with the literary reticence that proves a man the master also of himself. Born of London and bred of London,—he was a Bluecoat Boy, and is now Registrar of the East London Technical College [Peoples' Palace],—Mr. Hodson's paper is, in a word, racy of the super-subtle sensibility and insight which distinguishes all Londoners worthy of their grave and enviable citizenship. He would only add that he had received a letter from Dr. George Grierson, the eminent philologist, and Director of the Linguistic Survey of India, expressing his deep regret at not being able to attend Mr. Hodson's lecture as he had earnestly hoped to do.

The paper read was—

MANIPUR AND ITS TRIBES.

By T. C. HODSON.

The State of Manipur contains within the area of eight thousand square miles a remarkable congeries of tribes, all of which belong to the family of peoples to which the name Tibeto-Burman has been given. The heart of the little State is the rich and smiling valley, which holds two-thirds of the population and all the civilisation of the country. This is the broad land of the Meitheis, or to use the better known title, the Manipuris. The

population of the hills is a little over one lakh, spread over an area of seven thousand square miles, and falls into two main divisions, Nagas and Kukis.

Surrounded by mighty ranges of mountains, the valley of Manipur has yet attracted the attentions of conquering races, first the Shans, who in the beginning of the fourteenth century poured down into Assam from the confines of Yunnan, and then of the Burmese whose ravages, committed in the early years of the nineteenth century, wrought the utter ruin, military and industrial, of their ancient enemies. The wave of Hindu revivalism which marks the commencement of the eighteenth century extended to Manipur, where it secured the official adoption of Hinduism as the religion of the Rulers of the country.

During the period of British administration the Manipuri settlements in British India have received many recruits, some voluntary, many more or less against their wishes. In places like Nadia, Mathura, Brindaban, Hazaribagh, Dacca, Silchar, there are Manipuri residents and I am sorry to say, that in Cachar and Sylhet they do not possess the best of reputations. In Burma there are small colonies of Manipuris which owe their origin to the Burmese invasions, notably that of 1819, when over 30,000 people, artificers, craftsmen, and cavalrymen of the Kase Horse, were carried away into captivity.

Manipuris.

They belong to the Tibeto-Burman group of the Indo-Chinese race and have the well-known features of that division of the world's inhabitants. Beards and moustaches are rare, so rare that the fortunate possessor of any sort of hirsute decoration receives a special nickname. Of their origin nothing is known beyond legend, which is in their case peculiarly unreliable. Among all the hill tribes are current legends which give them and the Manipuris a common descent. Although I may seem to be anticipating somewhat, yet I think it satisfactorily settled that the tribes of the hills of the province of Assam are all members of one family. I hold this opinion to be based not only on the evidence of the recent linguistic researches, but on an undeniable identity of social structure and early religious system, and on the acknowledgment in the ancient chronicles of Manipur of the universality among them in former days of customs and practices which they have had to abandon since they adopted the formality of Hinduism and which to this day flourish among the hill people.

Dress.

I have referred to the ancient chronicles of Manipur. They are documents of great interest and afford us glimpses into more than the drum and trumpet history of the times. Here and there are mentions of the introduction of some elaborate sumptuary law, of some measure of internal organisation or reform, even of the details of the domestic life of the people. One result of the introduction of sumptuary laws seems to be great monotony, and the costume of the ordinary villager is certainly neither elaborate nor very picturesque. But every holiday affords an excuse for the display of a little finery, and those who are engaged in any sport or pastime naturally find it necessary to have a costume specially set aside for that particular sport. Thus we have the handsome boating costume worn by the steersmen of the boats which annually compete, or the peculiar costume appropriate for the wrestling matches, the most notable feature of it being the spiral headdress, which resembles that worn by the Raja on his coronation, or the horn into which the Marring Naga twists his hair. The men do not have a monopoly of fine feathers, and if the ordinary attire of the women is simple, it is also very dainty, for the stripes of the long petticoat which reaches from the arms down to the ankles are always tastefully matched. Indeed, the Manipuris are very particular to see that the Mohammedan women or Naga women do not wear colours reserved for them and fasten the garment under the left breast, while the latter have to wear it on the right. They have excellent taste in employing flowers as personal ornaments, and their jewellery is all of gold, filigree designs or simple beads being preferred. They and the women of the hill tribes add to the length of their tresses tails of false hair, which are bought in the great bazaar of Imphal. Before marriage custom demands that the girls should have their hair combed over the forehead with two locks at the side, while the dignity of the estate of matrimony is signalised by tying the hair in a knot at the back and combing it away from the forehead. The women in Manipur manage all the retail trade, and the gathering and breaking up of the great bazaar is a sight well worth seeing. The women stream in from all directions carrying their baskets on their heads and sit in rows in appointed places. The most difficult cases which I have had to try

were those arising out of bazaar quarrels. Every girl learns to dance, and the modest and handsome costume they wear sets off their slender figures admirably.

Houses, &c.

A Manipuri village is a long straggling collection of houses, each as far as possible with a separate frontage on the river. Imphal, however, the capital, is less fortunate in the matter of water supply, as the two rivers which pass through it do not suffice for the needs of the population, which is over 30,000. There are some pucca buildings in Imphal, but none, not even excepting the fort and kangla or coronation hall, are of any great antiquity. The Raja used to possess a ceremonial residence, made (not as has been stated in the Naga manner, but) in the style usual before the introduction of Hinduism, and this was called the "sang kai pun-si-ba" or the long-lived hut and granary. The houses are all thatched, though of recent years there has been a boom in galvanised iron sheets for roofing. The temples (public and private) are all of the trabeated style, and some of the teak beams used in the construction of the "natch ghar" are of great length and thickness. The Manipuris are fond of cheap lamps, and developed an annoying habit of stealing the oil lamps used for the illumination of the broad streets of Imphal. To thwart this we introduced acetylene lamps of a simple pattern, but the first night one was stolen. Retribution was swift, for the gentleman who stole it, opened it incautiously, and the gas which had been generated, caught fire and burnt his house down.

Industries, &c.

Of their domestic life little need be said. In the capital there are always attractions, and the daily gathering at the bazaar gives to life that relief without which it would be intolerably dull. In the villages there is a constant round of hard work, for the women take their part in the cultivation and look after the cattle, and spin the cotton and weave the cloths for the use of their lords and masters and for the family. In the valley, with its numerous lakes and jheels, fishing is a valuable industry. The women throw square nets with great skill, and the weirs and fish-traps are ingenious. A very curious method of fishing is practised by the Loi fishers who reside on the borders of the Logtak lake. They drive long bamboo stakes round the floating islands and moor them to the bed of the lake. They then surround the islands with nets and gradually lift the stakes and make fine catches. Many, if not most, of the industries of the country are in the hands of the Loi villagers who represent the original inhabitants of the country. They are ironsmelters, silk weavers, fishermen, potters, refiners of salt, limeburners, and manufacturers of sel, the small bell-metal coin of the country. The Manipuris are excellent cloth weavers and carpenters, and some of the gold and silver work is of fine quality. I have seen an ivory mat, on which the Raja used to sit in durbar, which is composed of fine strands of ivory, plaited into a strong texture, with threads of gold wire here and there through it. Caste prejudices seem to prevent them from turning their undoubted ingenuity to competition with the Lois. This is the reason why the schemes for the development of sericulture in Manipur have hitherto failed. The staple industry is agriculture, the chief crop being rice, which is grown in the fashion common in Eastern Bengal. So fertile is the soil, that in a bumper year the harvest is so plentiful that the price of rice falls to a mere song. In course of time the surplus will be exported to the tea gardens of Assam, along the cart road *via* Kohima. The Mohammedans, who have a "Kazi" of their own, and enjoy a fair tolerance, cultivate opium, which, I think, they sell in Burma, but the amount they produce is not large.

Games.

The Manipuris are fond of games, at which they are expert. Every boy learns to play hockey before he has attained to the dignity of clothes, and then those who can afford a pony learn the polo game, which I venture to regard as the gift of Manipur to us. The breed of ponies has sadly deteriorated of late years, but the skill of the Manipuris is unabated. The rules of the game require no more than seven a side, and a goal is scored whenever the ball crosses the back line. They are particularly expert at strokes on the near side, and I attribute their proficiency at a stroke which is full of difficulties to most European players, to the fact that, in order to protect their legs from blows at hockey, they always keep their sticks across guarding the leg, thus developing the muscles of the forearm much more than would be the case if they used the off side stroke to the same extent. The pastime of rambai hunba or dart-throwing is dying out, but it is a relic of the days when the Kase Horse were the most formidable arm of the Burmese

forces. The dart is a peacock feather with an iron point of some weight. Down the middle of this is a rod with a looped thong by which it is grasped. They whirl it in the air and at the psychological moment let it go. The missile travels 80 to a 100 yards with fair accuracy, and can be very easily discharged in retreat. Of the wrestling not much can be said except that the appropriate dress is very quaint. The foot races are also very keenly contested. But the palm for general interest must be awarded to the boat races. The Pannahs (or four revenue divisions of the country) each send in a crew, and by old custom the steersman of the defeated boat becomes the slave of the steersman of the winning boat, a custom which interfered with my plans for the promotion of sport among the military police, for the native officers of the battalion thought that it would be necessary for them to pay the usual fine of fifty rupees on each occasion of a race between the companies. The games take place during the Durga pujahs, and the Naga subjects of the State come down to Imphal in numbers to perform their characteristic war and other dances, a special day being set apart for them. There are sword players, and the event which draws the greatest crowd is the party of mimics whose performance is not always very decent. The great indoor game is kang, played with the round seed of the creeper, and it is identical with the game of konyon described by Captain Lewin. I shall later on have a word to say of the ballads of the country, but their recitation is a constant source of pleasure to the village folk, who listen to the token of love lorn couples, and the adventures of Ching Thang Khomba in his flights from the Burmese invaders with delight and interest. The way in which these ballads are recited by men ignorant of writing is to me an interesting proof of the manner in which the Homeric poetry was preserved in Greece before the introduction of writing. The language of the ballads differs about as much from modern Manipuri as the language of the Iliad from the Greek of Plato.

Divisions.

The Meitheis are divided into seven tribes, each of which has a chief, who is known as the "king" (Ningthou) of the tribe. The Raja is the chief of the Ningthouja or Royal clan. These clans are exogamous, though there are also one or two exceptions involving special disabilities on the marriages of members of certain subdivisions of the clans. There are reasons for holding that there were formerly ten clans. Two have disappeared, and one has been amalgamated with one of the present seven. The Brahmins are of foreign descent, and comprise fifty-one yumnaks. They come from various parts of India, such as Guzerat, Krishnagar, Allahabad, Santipur, Khanpur, Mathura, Assam, Orissa, Radha Kund, and Rai Bareli. Their ancestors are said to have come to Manipur, some at as early a date as the middle of the fifteenth century. The Lois, of whom there are not many separate villages left, are reputed to be the descendants of the early inhabitants of the valley, who were dispossessed by the Meitheis. The consolidation of the Meithei hegemony did not take place till the beginning of the fourteenth century, while the separateness of the Moirangs, still one of the most numerous and best localised clans, was preserved till our own days. The Mohammedans are said to be the descendants of captives taken in the raids which the Manipuris made in the heyday of their power on Cachar.

Internal Organisation.

Every Meithei belongs, in theory at least, to three social groups, the kei-rup or tiger club, formed to provide means for destroying the tigers and leopards which infested the valley; the sing-lup or wood club, which provides the wood for the cremation of its members and acts as a benefit society in helping its members; and, finally, the lal-lup or war club or militia. During the period of foreign aggression, when the Manipuris made war on Cachar and Burma and enjoyed a very independent position, the lal-lup was used for its proper purpose, but in the piping times of peace it was found expedient by the rulers of the country to employ the organisation on works of public utility, a policy with which little fault can be found. However, the people were soon put to work for the benefit of the Raja, and the system became one of organised oppression, which stifled the industry of the country. The internal administration of Manipur exhibits traces of Shan influence, and is remarkably complete. Each village possesses a number of officers each responsible for some duty connected with the Government of the locality, and though there is a tendency to assert that these offices are hereditary, I am confident that they went by favour in earlier days. But, corrupt as the methods of the Rajas may seem to us, their nominees have

been found to be very capable men. The relative precedence of all these functionaries has been carefully worked out, and when we introduced a chaukidari or village police, we had some difficulty in finding out the right position these humble officers were to receive at village festivals. The native courts were three in number, excluding the special court which took cognisance of offences committed by Brahmins. The Paja dealt with matrimonial suits and the Chirap with ordinary civil and criminal work, while military cases came before the Topgard. We have added a series of courts of first instance which deal with minor cases, while civil and criminal and appellate authority has been conferred on a new Chirap. The Paja has been abolished, its jurisdiction being merged in that of the Panchayets, while the political agent and his assistant have extensive powers of exercising control over the proceedings of the native courts from which they are courts of appeal. But in remote villages the people still have recourse to the simpler methods of ordeal and oath, though not to the same extent as is the case among the hill people. The bulk of the crime comes from the capital. There is very little crime against the person. Cattle theft is common, and there is, or ought to be, in the jail at the present time a man who had the reputation of being able to carry a calf through the bazaar without being detected. He modestly disclaimed this power. The jail I knew was not a prison, for no self-respecting prisoner need have stayed there a moment longer than he liked, as the walls could be climbed at any point; but I knew of only one jail-breaker whose exploits gained for him the nickname of Flyaway. I have heard Colonel Maxwell grimly assert that in times of famine he had to put the guard inside the jail to keep the people from breaking in. The village headmen acted as police in former times, but we have now established a civil and a military police force, which keeps us in close touch with the village officers whose authority has been maintained.

Marriage Customs.

The tribes composing the Meithei are, as has been said, exogamous, and the ceremony of marriage consists of the formal exchange of presents and cohabitation. Morality is lax and divorce is easy. In fact, the position of women in regard to marriage is that of slavery, and the price of adultery is that of a full slave in former times, viz., 50 rupees. Polygamy is practised especially by the members of the Royal family, the Raja being allowed four principal wives, and any number not exceeding 108 of wives of less dignity. In polygamous households custom regulates the attentions to be paid to the several wives in order of their seniority.

Inheritance.

The system of inheritance is, in general, devolution of the property to the youngest son, because the elders have, or are supposed to have, received provision during their fathers lifetime. Women have only a right to maintenance.

Tenure of Land.

All land is, in theory, the property of the Raja, but this theory has been disturbed by the rules introduced by us during the administration of the State, which provide for annual leases which are renewable unless in very special circumstances. Revenue used to be paid in kind, and the demand which was formally about one per cent. of the produce of the field, was raised by the time the tax was collected, to about twelve times the right amount. In order to secure payment of the indemnity and tribute, a money payment has been required, and the sudden change has undoubtedly worked some hardship, because there was a scarcity of coined money, and the only people who could command supplies of coined money were the foreign merchants in the bazaar, who have made handsome profits out of the situation. They keep the rates of exchange between grain and coin low or high, as it suits them, making a double profit on each transaction. I have known rice so low that it did not pay to employ labour on husking it. At the present time there is a grave need for determining the village rights which have grown up, over waste lands and grazing lands. I have known speculative investors who took out leases for waste lands and then charged the villages so much per head of cattle grazed thereon. One advantage of the annual pottah system was that it enabled us to deal equitably with such cases. A survey and settlement would be good for the people, though it would meet with strenuous opposition from the Manipuri authorities, who hope that the accession of the Raja will be the signal for the return of the old order of things with themselves on top.

Religion, &c.

I am sorry that I cannot emulate the easy brevity of Father Sangermano, who declares that the "people of Cassay worship the basil and other herbs after the manner of the ancient Egyptians." We have in Manipur an excellent example of the superposition of a stratum of Hinduism over the bedrock of an animistic religion. Formally, the religion of the State or the dominant tribe in the State is Hinduism which was brought into the country at an early date. The records of the Brahmin families warrants the belief that some of their ancestors reached Manipur at as distant a date as the middle of the fifteenth century, while the official adoption of Hinduism took place at the beginning of the eighteenth century. The recent census gave the Lois communities an opportunity of improving their social position as they were asked to state their religion, and promptly gave themselves the name of Hindus —much to the disgust of the orthodox. The addition of converts is still going on, for not only do whole villages drop the peculiar customs which mark them out as members of a pre-Hindu system, but individuals are constantly becoming "Hindus." Nevertheless the old religion flourishes, even prospers, side by side with Hinduism. The tribal head is the tribal priest, and annually performs certain rites of worship of the deified ancestor of the tribe, who, by a curious process of amalgamation, is popularly identified with some Deity of natural forces. Every householder is entitled to worship the "imang lai" or household deity on such occasions as births, marriages, and deaths, although he may be at the same time inviting the village Brahmin to come in and assist. By a natural induction the priest is also the doctor, for it is characteristic of animistic religions that all untoward or mysterious events are the manifestation of supernatural or spiritual power, and while prevention is recognised as better than cure, still a cure can only be effected by expelling the evil spirit which is causing the sickness, and therefore recourse is had to the "maibas" or spirit specialists. The "maiba" of the Manipur of to-day possesses some knowledge of herbs and drugs and uses massage freely in his treatment of ailments, but his association with divine mysteries is undoubted. They also believe in omens, dreams, and witchcraft. The most malevolent class of evil spirits are the "hing-cha-bis" or female ghosts, who eat live people. If a woman dies in child-birth, the calamity is attributed to a "hing-cha-bi," and the poor infant whose birth has been the occasion of such sorrow, is by some regarded as the "hing-cha-bi"—a belief which explains the custom found among many hill tribes of burying such children, alive or dead it mattered not, in the same grave as its dead mother.

Tabus.

Every Meithei tribe is associated with some object, in one case a reed, in another a buffalo, in a third a fish, which is not to be touched by the members of that tribe. The direst penalties, so terrible that they are beyond the reach of human imagination, await the impious wretch who wittingly or by accident breaks this prohibition, which is only one of many which have for their object the preservation of the clan from impurity. Special circumstances may cause temporary or limited tabu: thus when a man falls from a tree and is killed, the piba or head of the clan declares that tree to be tabu to the clan for ever. The purificatory ceremonies which precede the rites of the native worship in Manipur, whether the occasion be one of regular occurrence, such as the annual loosing of the scapegoat at the foot of the sacred hill Khabru, or are of an extraordinary and unusual nature such as the ceremonies for procuring rainfall, find their closest parallel in the remarkable tabus which invest the personality of the heads of the clans of a Naga village. The word "namungba" exactly corresponds to the Naga words "neina," "genna." Deeply seated is the belief in omens, and the annual loosing of the scapegoat is intended to secure good luck for the people during the coming year. Now Khabru is a very sacred hill, and the grassy plain at its foot is Kaithenmanbi or the gathering place of the ghosts. Again Khabru is the Deity peculiar to the Luang clan, and when there is snow to be seen on the summit of this, the highest mountain in Manipur, the popular and poetical phrase is that the God has spread his cloth, "Lai-phi tare."

Omens, &c.

Not the least important part of the coronation of the Raja was the determination by the assembled soothsayers, astrologers, and wiseacres of all sorts of the luck of the coming reign, which they declared was indicated firstly, by the length of time the Raja was able to sit on a pipe in an inner chamber, beneath which dwelt a fiery dragon, and then by careful observation of the stones on which the royal feet trod, in their

passage from the Kangla or coronation hall to the fortified enclosure of the Palace. On special occasions the Raja, the head of the State and therefore the chief priest, was able by the following ceremony to divest himself of his sins and to transfer them to some unhappy criminal who gained his liberty by receiving them. A scaffolding was erected, and on the top the Raja bathed himself while the receiver of the royal guilt sat below and received the sins and the splashings of the water. The Raja completed the transference of his sins by handing over his old clothes to the man below, who wore them and then went free. It was said that as long as the nong-sha or the animals of the Sun God, stone erections in front of the Kangla, stood safe and sound, so long would the good luck of the country and its independence continue. They survived the Burmese wars only to be destroyed in 1891 for reasons of high policy. Every year the luck of the State as well as the issue of the year was determined by the appointment of a name-giver Chahitaba. The Maibas nominate a man whose horoscope is in favourable relations with the general signs. He then worships the Raja addressing him as the incarnation of Pakangba, the divine ancestor of the royal clan, and undertakes to bear all the misfortunes of the country and the sins of the Raja till the end of the year, when custom demands that all Manipuris should wear new clothes and throw away all their old cooking pots. At the end of a prosperous year the namegiver is rewarded, and I once heard a deputation urge on the Political Agent in all seriousness the proposal that he should fine or imprison the chahitaba or name-giver of the year whose unrighteousness was clearly demonstrated by the epidemic of cholera which had decimated the State.

And the Brahmin flourishes in this atmosphere. I do not doubt that the elaborate system of tabu rules which has left such remarkable customs behind it, enabled the early missionaries of Hinduism to argue that only a very little was needed to make the people of Manipur very good Hindus. The Maiba is left in peace and the celebrations of the nature worship never interfere with the worship of the Hindu Deities. The system of caste is based on tabu rules, and we shall see in the hills of Manipur an embryonic caste system maintained by the declaration that the particular industry which is associated with it is tabu to members of other communities, who are so far susceptible to regard for such a prohibition that they disregard their own interests and forbid their people to practise the art of cloth weaving.

Ballads.

Superstitions abound, for to the extravagance and fancies of animism are added the signs, wonders, omens, and portents in which the Hindu places full and implicit belief. The ballad mongers of the country recite the woes of Dhanan jai, the saint and mystic, alternately with the tale of Numit kappa, or the man who shot the sun. The virtues of asceticism and charity to Brahmins are the theme of the one, while the other is probably a genuine native production, and for that reason of greater interest. In it they tell how in early days there were two suns, the one of which rose as his brother set. The slaves murmured at this addition to their burden, and one, bolder than the rest, fashioned unto himself a bow and arrow, wherewith he practised until his aim became perfect. Then he lay in wait, and, carefully aiming, struck the Sun God from his horse as he was about to begin his career through the heavens. The Sun God, wounded, fled in terror, and his brother with him. For ten long days the Sun Gods lay hidden, averting their faces from the sons of men who had done this outrage upon them. For ten long days the land lay in darkness, and no man worked, and the crops perished, and the cattle died, and the plight of the land was sorry indeed. Then the king took counsel of his wise men, and made prayers to the gods, who helped them not. Then the ten kings of the country and the ten gods of the country turned to the wise goddess who knew the interpretation of dreams, and besought her to plead with the Sun God, but he would not relent for her entreaties. Then they went to the Princess Panthoibi, for she had knowledge of many mysteries, and she showed them the magical ceremonies which would induce the wounded deity to take pity on the land. These things they did as she showed them, and at last the Sun God relented and came back, but his brother, the wounded deity, never returned to the abode of wicked men.

Hill Tribes.

The hill tribes are divided into two main groups, Nagas and Kukis. In general, it may be said that the Nagas live in permanent villages with no definite village chief in secular matters, while the Kukis are disposed to move their villages periodically, and own

obedience to a chief. There are, however, subdivisions which form links between these groups although they are linguistically distinct. There are Kuki villages which we know have occupied their present sites for several centuries, there are Naga villages which keep to the village site while practising a rotation of cultivation, and if the authority of the headman of a Naga khel is almost entirely sacerdotal, extending only to secular affairs by stress of personal ability, the exclusion of a Kuki Raja from sacerdotal authority is limited by a custom which demands his presence on occasions when his people are specially tabu, occasions which equally involve a Naga clan in tabu, a fact which goes far to prove, or as the cautious Oxford don put it, to render it extremely probable that there was once a time when the head of a tribe or clan, Naga and Kuki, was invested with authority in sacred as well as in secular matters, and that their divergent development is due to accidents of history which we may guess at but with which we are very imperfectly acquainted. While I adhere to the general classification I preserve a profound belief in the ultimate homogeneity of these people in spite of the differences of coiffure, dress, speech, houses, and methods of agriculture.

We have in Manipur the following Naga tribes:—Mao, Maram, Tangkhul, Marring, Kabui, and others such as the Quoirengs, Khoiraos and Liyangs. The Mao and Maram tribes inhabit the hills bordering on the Naga Hills District on the extreme north of the State, while the Tangkhuls, a large and enterprising tribe, occupy the hills to the east and north-east of the valley. The Kabuis hold the hills on the west and north-west of the valley, and the Marrings are found in the hills south-east of the valley. The Quoirengs, Khoiraos, and Liyangs are found in the hills north and north-west of the valley. The Kukis are found in small settlements dispersed all over the State and comprise the old Kukis in the south and a number of dependent tribes such as the Waipès, Dvites, &c., all of whom are settled in the south of the State.

Classification.

The labours of the Linguistic Survey of India enable us to classify these tribes according to their linguistic affinities. The Mao, the Maram, the Tangkhul, and the Marring Nagas are placed by Dr. Grierson in a sub-group to which he gives the name Naga Kuki, indicating thereby that their languages approximate to both standards, the Mao and the Maram dialects being more allied, as their geographical propinquity would lead one to expect, to the true Naga languages, while the Tangkhul and Marring dialects present features of considerable similarity to the Kuki Chin languages. It is, therefore, possible to consider them as links between the two groups, the true Nagas on the north and the Kukis and Chins on the south. The languages spoken by the Kabuis and the Khoiraos belong to another sub-group, the Naga Bodo, and are thus to be regarded as a link between the Naga languages and the Bodo dialects such as Mech, Garo and Bodo. Dr. Grierson also points out that there are many points which indicate a connection with the Kuki languages in both the Kabui and the Khoirao dialects. It is natural that Kuki influence should be predominant in Manipur as the Meithei language is a member, the most important member, linguistically as well as politically, of the Kuki Chin group of languages, and it is certain that as the rule of Manipur was extended over these tribes the language of Manipur, the *lingua franca* of a large part of this area, followed it. The Manipuris never learnt the languages of their subjects but imposed upon them the necessity of learning Meithei. It occurs to me that it would be a matter of great philological interest if some scholar on the spot were to collect the songs sung by the Nagas and Kukis on their high days and holidays as these are in a language which is so archaic as to be unintelligible at the present day to the members of the tribe. The same is true in Manipur, but I have some specimens of the ballads of Manipur in the early dialect, with a version in the modern language, which show the lines on which the development of the language has taken place.

Origin.

Among all the tribes in the Manipur State is current a legend which connects them with the Kukis and the Manipuris. The legend is constant in declaring that the Kukis are descended from the eldest of three brothers; that they are the children of the second, while the Manipuris are the progeny of the youngest. Some support this story by pointing to the fact that the Manipuris have the best share in the valley, while the Kukis are kept to the barren hills, where only by jhuming can they subsist. Others find it buttressed by a tale that one day the three brothers were playing in the village, and started a jumping competition. The

eldest, the ancestor of the Kukis, cleared the jump; the father of all the Nagas just failed to get over it, and got his hands and feet muddy; while the Manipuri fell right into the mire; and so from that day to this the Kukis do not wash at all, the Nagas wash only their feet and hands, and the Manipuris bathe regularly.

There are other legends, especially among the Tangkhuls, which declare them to have sprung from the valley which they left because the heat and the mosquitoes made life unendurable. In another case they say their ancestor came from a village Maikel, which is by another tradition the place of the origin of the ancestor of all the hill folk. The Dvités, who are living in a state of servitude to Kukis, say that once upon a time two eggs were found in a paddy basket belonging to Aisan, King of the Thados. One was cooked, but from the other, which hatched out in the warmth of the sun, there sprang a beautiful lad, who became the ancestor of the tribe.

Appearance, &c.

In appearance all these tribes are distinctly non-Aryan, though I have seen men, especially among the Tangkhuls, who have a well-cut profile. One seldom sees a Naga or Kuki with hair on his face. It is easy to distinguish them by their different styles of dress, and by the peculiar manner in which they cut their hair, for one of the points which distinguishes a Naga from a Kuki is that the Naga cuts his hair, while the Kuki does not cut it, but ties it up behind. The Tangkhul fashion is to cut the hair closely at the sides, leaving a broad band in the middle, which is parted and tied in a tail at the back. The Mao and Maram Nagas either cut it at the sides—but not to the same height as the Tangkhuls—or they allow it to grow in thick masses of curls, which, unlike the Manipuris, they think an embellishment to beauty. The Kabuis adopt the Mao fashion, which resembles that of the true Angamis, their immediate neighbours on the north. The Marrings do not cut their hair, and, while the Kuki coils his hair at the back, the Marring twists his into a curious spiral horn in front, through which he thrusts a steel bodkin, which is put to a number of various uses, almost as many as a lady's hairpin. They say that this bodkin is a relic of the time when they knew how to read and write, and the steel bodkin was the implement in vogue; but the dogs greedily ate up the skins while the men were bathing, and from that day to this the useful art of writing has been lost to them. But it is interesting to note how the fashions are even now susceptible to modification, for I have met Tangkhuls who wore their hair dressed in the Marring fashion, and others who would pass as Kukis by tying their hair back when long enough. Throughout the hills we find that the girls have their hair either cut short and only allowed to grow just before marriage, or, if worn long before marriage, then combed back and knotted at the back, like the Manipuri unmarried girls. Here, again, it is reasonably certain that if one meets a girl with her hair cut short, she comes from a Naga village, while the Kuki maidens keep their hair long. The Tangkhul and the Marring Nagas have no certain and general fashion, as in some villages the girls have the hair cut, in others long and uncut.

But the cloths worn by the several tribes afford as good a means as any other of distinguishing them, because they adhere most strictly to the colours which custom has prescribed as peculiar to their tribe. Thus the Tangkhuls wear blankets of red and blue stripes, the Maos and Marams keep to cloths of a pattern similar to those worn by the Angamis, white in the centre with red and blue stripes round the edge. The Kabuis wear a plainer cloth, the centre being blue with white and red edges. The women also have their distinctive colours. Those of the Tangkhuls, especially in the great weaving villages, are handsome and varied, and the colours they use are blue, white and red. Among the Liyangs I noticed women wearing petticoats with yellow or kharki coloured bands with black stripes about two inches wide in between. The Maos and the Marams are kilt wearers, and in some cases the men of Liyang and Khoirao villages wear either the kilt or the waistcloth with the fringed pendant ends which is worn both by the Kabui and the Tangkul. On the gala days when a dance is to be performed the men assume an unusual amount of finery. Nothing is more remarkable or picturesque than the peculiar attire of a Mao or Maram warrior. His head-piece is a wicker helmet with a brass or bell metal plate in front and a chin strap of wood covered with red berries and green beetles wings and round ear pieces decorated the same style, while from the lower edge of helmet hang tresses of hair, in older times the signs of successful raids. A great warrior may wear a decoration of goats' hair dyed red and yellow and black, which betokens valour in the field, and he girds on a tail, a piece of

wood projecting about three feet with tails of goats' hair dyed red and black hanging from it. But this also serves a useful purpose as there is a receptacle in it for panjis or sharpened bamboo spikes with which to impede the onset of an enemy. His leggings are of finely plaited cane work in red and yellow bands. Instead of a helmet some wear a strange head dress like a pair of horns in light cane and ornamented with red and yellow bands. The hair is tied up at the back in a tight knot fastened down by a coil of cotton wool which is also used to decorate the lobes of the ears. The weapons are an oval shield of wicker work covered with the skin of a bear or with black cloth having a red band down the middle, a spear about nine feet long, which for show purposes is ornamented with red and black goats' hair and the universal dao. Some of them have guns which are produced on such occasions as village festivals. The Maos and Marams wear the ivory ring over the arm and a shell round the neck, while the Tangkhuls prefer a brass necklace with hairtails and brass rings. But there are special cloths for the chiefs, and the fate of the rash man who would dare to wear a chieftain's robe is not capable of precise definition, as there is no case of the sort on record. These cloths are generally ornamented with fringed ends and a handsome border of yellow, red, white, and green pointed decoration. The more expensive cloths have the sign manual of the weaver woven in the hem generally as a lozenge-shaped ornamentation in coloured threads. Kukis wear a dhoti and a pagri, and their women wear petticoats of a dark blue ground with woven patterns of light blue.

ORNAMENTS.

I have incidentally referred to some of the ornaments worn by the men. They and the women wear necklaces of polished cornelian beads by which great store is set. Among one tribe, the Tangkhuls, and then only in the most distant and least wealthy villages, is tattooing practised. They told me that it was done to enable them to identify their wives in the world hereafter, and that it was introduced among them by the Chom Ningthou, a mysterious personage who seems to be connected with the Shan States beyond.

AGRICULTURE.

The Nagas practice both the irrigation system of agriculture and the method which is known in these hills as jhuming. The water channels are of great length, and the ingenuity with which these savage engineers overcome obstacles is always a marvel to me. I have seen water brought four miles and the source would be only a few hundred feet above the fields. The rules regulating the distribution and enjoyment of the water are very complicated, but have as their end the fair and equable supply to all the fields in turn. The jhum system*, which is practised by Kukis, even when, as is the case with the old Kuki villages, they have permanent village sites, is wasteful in the extreme, and is only practised where the slope of the hills and the nature of the soil make permanent fields impossible. The Mao Nagas surround their villages with rows of polled trees, and their cultivation is in general the finest in the hills. The staple is rice, but they grow winter crops. The Kabuis practise a regular rotation, but annually go through a solemn ceremony of taking the omens to determine the direction in which the cultivation for the next year is to be. Their villages are permanent though they change the area of their cultivation from year to year and subsist, almost entirely, by jhuming.

HOUSES, &c.

The houses of the Naga tribes approximate to one type. They are built with sloping ridges, high in front and low at the back. In general the houses are thatched with grass, but the Tangkhuls use pine planks. The floor of the house is the earth well trodden down, and the furniture is not extensive, a few baskets, a dhan pounder or two, and the hewn logs on which the rice is pounded. The villages are irregular, and in former times were surrounded by a stockade, but the policy of Manipur has been throughout one of steady disarmament. Built on the top of ridges of branches of the main ranges, they are well elevated, and though water is at some distance, they occupy formidable military positions. In every village are small platforms on which the village gossips sit and smoke their pipes. The interior of a Naga house is only one degree less filthy than the lane outside. The most conspicuous house in any village is as a rule the bachelors' club, wherein they sleep and live in strict discipline. Great social merit accrues to the public-spirited individual who gives up his house to the bachelors.

Kuki houses are generally raised from the

* "Journal Society of Arts," Vol. xliii. (1895), page 178.

ground with an open verandah in floor. Each house is surrounded by a stockade, and a fence protects the whole village, the centre of which is the chief's house. As a rule the Kukis build their villages in secluded spots in the jungle, and have in a few instances established their abode alongside a Naga village, much to the disgust of their neighbours.

INDUSTRIES.

Nearly all the Naga and Kuki tribes make their own cloths at home, but in the case of the Tangkhuls, six villages, all in close proximity to one another, specialise in the manufacture of cloths and are rapidly forming a caste of cloth weavers, for they do their utmost to prevent their girls marrying into other villages, and I know a woman who married a man of a foreign village, and when she attempted to weave cloths in her new home, the villagers stopped her saying that it was not allowed to them to make cloths, and that misfortune would come to them if she introduced this new industry. The Tanghuls present us with other cases of specialised and localised industries, viz., salt making and pottery. They do not use the wheel, but mould the pots round a bamboo cylinder and curve it into the required shape by hand, adding geometrical patterns at a later stage. This industry is only practised in the neighbourhood of outcrops of suitable clay. The salt wells are found in the extreme north-east of the State, and are generally in close proximity to the beds of rivers. The brine is evaporated in shallow iron korais, which are hired from the State for a small annual sum.

HUNTING.

The Nagas are fond of hunting in large parties, and have elaborate rules as to the disposition and sharing of the quarry, and any neglect of these rules leads to serious trouble. Some Naga tribes use a poison to stupefy the fish, while the Tangkhuls drive the fish into the shallows or use seine nets. Kukis, however, hunt singly and track their game. They have the art of making a crude sort of gunpowder, and their traps, pitfalls, and snares are most ingenious.

SPORTS.

The sports of the Nagas and Kukis are simple, consisting of weight-throwing, weight-lifting, jumping and dancing, and in all the villages one may see an eager group watching the progress of a game of draughts between two champions. They also play the game of kang with the seed of a creeper, and they have an elaborate game very similar to the game of fox and geese. I have seen small boys with whip tops. The girls sometimes join in a game of kang, but marriage brings them so many cares and duties, that they have little time for games, having to fill their spare time by smoking their pipes as hard as they can to get the juice for their husbands who sip this nauseous liquor when on a journey, and consider it extremely palatable and sustaining. In a Kuki village I saw some small boys walking on a pair of stilts. The Naga dances are interesting, but the Kukis have in general the reputation of being the better musicians. The Tangkhul Nagas are expert buglers, and the Kukis have a musical instrument, consisting of a gourd into which are inserted first a pipe through which the wind is blown, and then seven pipes each fitted with a vibrating reed, for the production of the tones.

ORGANISATION.

It is not easy to define a tribe with reference to Nagas, as they themselves do not recognise any tribal unity; they have no tribal head, and apparently no tribal deity. So far as my enquiries go, they tend to show that linguistic unity is recognised by the Nagas as one of the constituents of a tribe, and that each tribe has a tribal tabu. I obtain the first element from their marriage laws, which forbid the marriage of people of different tribes, and I find that in practice this means people with different dialects. The second element is much more obscure, but in two cases, the Marams and the Tangkhuls, there is a general tabu object—in the former the pig, and in the latter the goat—which may not be eaten by any members of the tribe. The Maram story about the manner in which the pig came to be forbidden to them shows clearly enough that it is a true totem, and that they hold themselves to be considered to be the descendants of a porcine ancestor. The Tangkhuls say that goats are very human and like children, and that any man who eats goats' flesh will go mad and die, and they do not keep goats in consequence. The common unit recognised by the Nagas is the village, which is a collection of clans each feigning descent from a common ancestor, and living in close propinquity, with common food prohibitions, and worshipping all together at the same time. These elements—community of descent, commensality, propinquity, and a

common family worship, are strongly marked, and affect the whole of their social and religious life. Marriage is strictly forbidden between members of the same clan, and as strictly forbidden outside the tribe. All rules of inheritance are based on the principle of male agnatic succession, and default of male heirs is hardly possible, because it cannot occur unless the whole clan is extinct. Women on marriage cease to be members of the clan in which they have been brought up, and, while they have a right to a share of the moveable property of the family, they cannot under any circumstances take land away from the tribe. Land is held in severalty, and may be disposed of by sale or gift, but not to an outsider. The Tangkhuls have a curious custom of inheritance which renders it necessary for the father of the family to move out when his son marries, and the same rule applies to the succession to village offices. In order to defeat our revenue law, by which the villages are taxed according to the number of houses in the village, this custom is being abandoned, and smaller huts in immediate contiguity to the former house are constructed. The Kabuis have a custom—which is not peculiar to them, as it is also found among the Kukis in their neighbourhood—of paying the "price of the bones" of a wife to her parents or nearest male relative on her death. The fixed rate is one cow. In certain circumstances the payment is remitted, viz., when a woman dies in childbirth, or is killed by an enemy or by some wild beast, or dies of cholera, or when she dies away from her husband's house.

Marriage Rules.

Among Kukis and Nagas marriage is a matter of price, and while some tribes allow the *Times* system of a deposit, others insist on full payment before the bride is brought to her husband. There are many marriages of inclination, as may be expected in a state of society where the women are not secluded, and where custom permits a considerable degree of licence before marriage, while insisting on the strictest fidelity after marriage. There are certain points about the marriage price which need some consideration. The price varies very considerably, and its variations are due to many causes, as for instance among the Maos and Marams, fierce fighting folk, whose numbers have been thinned by internecine feuds, the price of a bride is low because men are scarce, and it is strictly fixed by custom. Among the Tangkhuls a woman from the northern tribes used to fetch a higher price than a southern woman because the men of the north were more ready and more able to avenge illtreatment than the men of the south, an example of the way in which exogamism tends to put an end to feuds. The Kukis, a people with a strict monarchical system, pay more for their brides if they are the daughters of Rajas than for the mere commoner. Then among the Anals, a small village of Kuki origin, we have the system of payment by service, the son-in-law actually serving as a servant in the house of his father-in-law for three years. Is payment by service earlier than payment by exchange or cash, and is the curious custom of mandu (or payment for the wife's bones) in any way connected with the price of the bride? Divorce is not easy and is expensive. Polygamy is allowed but is rare.

Oaths and Ordeals.

The village authorities deal with many village disputes, and the employment of the oath or the ordeal is general. Some of the oaths are very quaint. The Kabuis take a handful of rice, some ashes, and some salt and dust. They mix the rice with the ashes and declare that they will find all their rice spoilt as this rice is if they lie. Then they mix the salt with the dust, and say, "May our salt turn to dust if we lie." There are oaths on the spear or dao, or on the tiger's tooth. The Mao Nagas are very particular in employing different oaths in the different kinds of quarrel. In a case about land the oath is to be taken on the earth, while if the dispute is about a wood or jungle, the oath on the axe may be employed. When the case is between two villages or two clans of one village, then the oath on the body of a cat is used. Similarly among the Tangkhuls one can get an increasing range of liability by making the persons swear on the village instead of the clan, and a common ordeal among them is to give the verdict against the village which first loses a life, be it of a child in arms. The water ordeal is use in the following manner. Each village produces a champion who grasps a stone at the bottom of a pool, and at the word, dives below and holds on as long as possible, and the verdict is given to the village whose representative holds himself down longest. After all, these are crude ways of appealing to providence to decide a matter which is incapable of solution by human ingenuity.

Religion.

The religion of the hill tribes is animistic, but they all have a definite scheme of deities presided over by a chief, the Creator who is now inaccessible to the prayers of man. Below the regular ranks of the deities are the spirits, some of whom are the ghosts of human beings, especially of those whose manner of death indicates divine displeasure, and to propitiate them is the business of the wise men who are called in to diagnose the cause of sicknesses, *i.e.*, to say what spirit is causing the poor fellow to be ill, and the sacrifice which will appease or drive the evil visitor out. There are two sets of beliefs about earthquakes. The one current among the Tangkhuls and the Kabuis is to the effect that earthquakes are caused by a deity who resides underneath the earth, and who is disturbed by the fear that all men have perished, and when he shakes the earth, they all cry out, "We are alive." The other belief is that the earth and the sky are the female and the male principle respectively, and that earthquakes are due to their embrace.

Genna.

The foundation of their worship is the system of "genna," which in many respects corresponds to the tabu system of the Polynesian peoples. I have found it convenient to deal with it by a somewhat careful analysis into "gennas" affecting first the whole community, then to deal with those which only concern classes of individuals or sections of the community, and then those which involve individuals. In the next place, there are "gennas" which are of regular occurrence, and some which are occasioned by events of an unusual nature. Finally, there is the mechanism by which the "gennas" obtain validity.

The "gennas" which affect the whole community are the public festivals for the crops, which vary in number from some twelve to three, and are occasioned by the stages of the cultivating season; and the annual festival at which the spirits of those who have died within the year are laid to rest by the participation of the whole village in funeral rites. It is a common feature of these village "gennas" that at their commencement the gates of the village are closed against all comers until the end of the ceremony. Now, if there is any unusual or extraordinary occurrence, such as the death of a woman in childbirth, the destruction of the village by fire, the advent of an epidemic sickness, or an earthquake, or an eclipse, the whole village is "genna" for that day. At some of the crop "gennas," especially those which celebrate the beginning of the cultivating season, the men and women eat and cook apart. During the whole of the time that the crops are in the ground or are unharvested, the practice of any trade or industry and the playing of all games is strictly forbidden. The Kabuis have a "genna" at which they wash the tired implements of their rude agriculture in a running stream, after which they hang them up till the next year.

There is another class of "gennas" to which I must draw your attention because of the peculiar ethnological interest which attaches to it. The prohibition against certain articles of food is described as a "genna," and in the same manner the rule which forbids a Naga to practise any trade or industry from the day of the "genna" which celebrates the beginning of the cultivating season to the day when they have the harvest-home festival is also a "genna." Now, these "gennas" are of general validity, and affect all the members of the community. The reason for "gennas" restricting the trades and industries may be the desire to give all the available energy of the village to the task of looking after the crops, while the effect of the "genna" rule, which disallows all fishing, hunting, playing, and sports, cutting of grass and timber, is to enforce a close season which is necessary.

The "gennas" which touch only classes of the village or clans are less numerous. Among the Tangkhuls, the clan is "genna" for the death of one of its members; while in certain villages I have found a "genna" necessitated by the death of a cat. The prohibitions with regard to dietary matters are complicated by much local variation, but girls who are unmarried, and women who are about to become mothers, are restricted in their range of diet.

An individual may make himself "genna" in many ways. For instance, a man who aspires to notoriety may decide that the state of his finances will allow him to erect a stone monument, and for the time he is surrounded by "gennas" of the same nature as those which protect the "khullakpa" from ceremonial impurity. Afterwards he gains certain prized privileges, such as permission to wear a chief's cloth, but he has to submit to restrictions which some of them find annoying.

Among all tribes a case of death brings a "genna" on the inmates of the house where it happens, and even if the death be that of an

animal, the "genna" is necessary. If a child is born in a house, the inmates are "genna" for at least one day, while the parents are "genna" for a period which may extend to four weeks. Some, not all, tribes, exact a "genna" for a birth of an animal in in the house.

The individual who is most protected by "gennas" is the "khullakpa," or the head of the village. He is the recognised intermediary between the greater powers and the people of his village. He officiates on all public occasions of worship, and it is necessary that he should be completely free from all ceremonial impurity, which would vitiate the rite entirely. If an epidemic sickness visits the village, he declares a "genna" and manages it. If rain has not fallen, he undertakes to propitiate the offended powers, and the whole village is "genna." He may not eat many things which are allowed to the common herd, and before all "gennas" commence he must not eat anything that has been cooked in an old pot. The Maos, alone of all the Naga tribes in Manipur, have a high priest who may not eat anything in a strange village, and it is a curious fact that there seems to have been a movement of dissent among the Maos some centuries ago according to their traditions, and now the headman of one group is anathema to the members of the separatist party.

A word or two about the sanctions of these "gennas." The first, and perhaps the most important thing, is that they are absolutely vague. No one knows the exact results of an infringement of any of the rules. It seems to me certain that within the mystery there are degrees of unimaginable penalties, for the rule against the intermarriage of members of the same clan is absolute, while there are other rules the breach of which can be condoned, or the results of a breach of the rule can be prevented by timely sacrifices. In no case is it within human knowledge to say how the spirits will deal with any case of disobedience, and, so far as one can judge, there is no difference between the sort of penalty that accrues from a disregard of the rule forbidding a woman to eat dog, and the result of a more flagrant act of defiance. The penalty may affect the guilty individual only, but it is quite as likely that a whole community will be punished for the sin of one, and guilty intent is no element in sin according to these ideas.

"Genna" is, therefore, not only a religious system, but it is the foundation of law among these people, and it provides the mechanism of their legal system as well. The separation of morality from religion, of law from religion, cannot take place in a state of society governed by such ideas as these, and when a Naga trusts his case to the arbitrament of an ordeal, he believes that High Heaven will punish the offender as surely and as mysteriously as in his belief it punishes those who break these rules.

Name-giving.

Before the end of the period of seclusion which follows the birth of a child in a house, a name has to be given to the new arrival. It is not necessary that this name should be that by which the child is to be known throughout his life, for the actual name may be chosen at a later date. The reason why a name must be given without delay is that the possession of a name is a protection against evil influences, which are especially active against young children and mothers at the time of childbirth. But the name has also an influence over the owner of it all through life, and care must be taken to see that the name is not unlucky. Therefore, they have recourse to omens taken from the dreams of the parents; to omens given by the condition of the fowls killed as an offering to the household deity at the child's birth; or in some cases they make the child the arbiter of its own fate by proposing names to it, and rejecting those at which it cries. One tribe has evolved a curious custom of giving names in accordance with a regular scheme determined by priority of birth, but there is some evidence for the belief that this system only conceals a private name which is strictly tabu, and if made public the only way of expiating the sin is to give a village feast and to assume another private name. As a result of this custom, the employment of nicknames is necessary to eke out the rather limited supply of authorised names.

Head Hunting.

One of the customs by which the hill people have earned an evil reputation is that of head hunting, and the raids in which they indulged were the reasons for the numerous expeditions which were sent against them, and which culminated in the occupation of the hills. I have been able to trace this custom to several causes. There is, firstly, the desire to provide a departed chief with a retinue of slaves in the future world, which accounted for the Kuki raids on the tea gardens of Cachar. Then

there is the very common belief that a human sacrifice brings fertility to the fields, and to this belief I attribute many cases of isolated murder. Village feuds account for many of the troubles, and, as it is a point of honour to keep up a feud as long as a head is owing from the hostile village, the difficulty of settling such feuds is great. Nowadays, when a village comes under British protection, one of the first steps taken by the officers in the hill districts is to persuade them to surrender all the heads in their possession, and in return to receive the heads taken from them. Finally, an episode which happened to me indicates another source of mischief. I once met in the hills a poor trembling wretch, who implored my help against the headman of a neighbouring village who was building himself a new house, and, to give it strength and stability, had cut a lock of this fellow's hair off, and buried it under the main post of the house. In the old days, I was told, the man's head would have been cut off and put there. Civilisation had so far produced a modification of the former custom, that only the hair had been cut off; but that was nearly as good, because they believed that the man's spirit would never rest until he had got the missing lock of hair back, and to get it would have to go underneath the house and be imprisoned there. I had the lock of hair duly disinterred, and it was burnt with proper ceremony.

Funeral Customs.

A word as to the funeral customs in vogue among the Nagas and Kukis. Both practice burial, and place in the graves the weapons and implements used by the deceased when in life. The graves of those who meet with sudden, violent, or mysterious deaths, are invariably dug by special classes of persons, with special protective ceremonies. The Kukis dispose of the bodies of their head men or chiefs in a remarkable manner. The corpse is placed inside a hollow log, which is then sealed down with mud. A pipe is inserted in order that the products of decomposition may be removed, and at the end of three months the covering is taken off and the bones dried and kept in the house. All erect monuments in commemoration of the dead, and while among the Nagas the direct intention of the monument is in some measure forgotten, many of the stone monuments in the vicinity of the Naga villages owe their existence to the desire for preserving the memory of the departed. The Kukis make an enclosure, inside which they place small stones in rows. The Tangkhuls erect stumps of trees inside the village, and stones outside; while the Koirengs —a tribe of Kuki affinity—erect cairns of a beehive shape. The largest stone monuments are those erected by the Mao and Maram Nagas. They are for the most part upright monoliths, about 12 feet high, a foot thick, and about 8 feet broad. Their weight must, therefore, be considerable. In the neighbourhood of the once large village of Maram is an avenue of stones, near which is a flat stone supported on three other stones. Every year before going out hunting the Nagas try their luck by kicking stones on it, and the man who first succeeds in lodging a stone on the top is regarded as likely to kill an animal. But the most remarkable collection of stones is that which exists in the neighbourhood of the tiny village of Uilong, two marches away from Maram. I have been told that I was the first British officer to visit this spot, and, from the absence of any description of the stones in earlier official records, I am inclined to believe this to be the fact. As I climbed up the hill, I observed by the side of the path a row of stones following the winding path about 18 inches in height. I then came to some stone steps which led to the ring of stones. There are 32 stones, arranged in a circle containing 14, with a single row of 18. These stones are of an average height of 10 feet, and are about 4 feet apart. The first stone is due east, and the people of the village dance inside the circle on "genna" days. There are many superstitions connected with these stones, and the whole village is "genna" during their erection, but since the diminution in their numbers the practice of erecting stones has fallen into desuetude. However, we are able to restore some of the customs from other villages where the stones are still erected. Tradition says that the Uilong stones were placed in position some 300 years ago. The descendants of the men who erected the stones in the first instance are believed to continue in prosperity so long as the stones stand, and in this belief may be found the reason why some of the Nagas offered very strong objections to the conduct of some Public Works subordinates, who used some of the fallen stones in the immediate proximity of the cart road as road material.

I have endeavoured to give as brief, and yet as complete an account as I could of the salient features of the beliefs and customs of the tribes inhabiting the State of Manipur. I

fear I have far exceeded the limits of space allowed by the rules, but I suffer from an *embarras de richesse.* I have touched on many matters, and if in one or two cases I have referred to what may be called politics, my excuse—and I hope it will be accepted—must be that I was always fond of touring amongst these people, and I soon learnt how necessary it was to deal with them direct, and to ascertain from their own lips their history and traditions. I used to take a magic lantern with me when on tour, and gave shows in every village, and I am now glad of this opportunity of redeeming a promise which I made to them, that I would tell my friends in England what I knew about my friends, the Nagas and Kukis of Manipur.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said he could not stand in the way of others who, because of their personal and official knowledge of Assam, he hoped would address the meeting; but before taking the liberty of calling upon them to speak, he would wish to make two observations. One was to congratulate the Indian Section on the growing strength of the representation of India in the ever increasingly useful work of the Society of Arts. Each succeeding year the standard of the papers in the Indian Section rises higher and higher in literary quality, in practical utility, and public importance; and what was still more remarkable was the way in which Indian subjects were now being dealt with also in the other meetings of the Society of Arts. Only the previous night he had taken the chair, at the Ordinary Meeting, at the reading of a paper of rare interest and ability, on the architecture of Futehpur-Sikri, delivered by Mr. E. H. Hankin, and to-night it was his equal good fortune to preside at Mr. Hodson's lecture, one of the highest scientific value ever submitted to the Indian Section, and like Mr. Hankin's paper, delivered with a spontaneity, a dash, and an effectiveness that had held his audience, as did Mr. Hankin his, enthralled from start to finish. This was highly creditable to the Indian public services; and not less, he ventured to say, to the Society of Arts. It was also a matter of congratulation, in the highest interests of the public, that an institution which was doing such good work as the East London Technical College, should possess among its officials, a gentleman of Mr. Hodson's accomplishments, energy, and Indian experience. He hoped that these observations of his would be noted in India, for he was satisfied that nothing would be of greater practical advantage to the rising generation of the people of India interested in the acquisition of technical knowledge than that they should seek in yearly enlarged numbers to enrol themselves as members of the Society of Arts. The other observation he would desire to make was less altruistic and more egoistical. What had held him absolutely spell-bound, until, by what seemed the sudden close of the paper, he was awakened as from a dream, was the decorative patterns, embroidered and woven, on the clothing,—all true manufactures, and not machinations,—made and worn by the men and women of Manipur. This "Happy Valley" seemed to be not merely a reserve of historical antiquity, but of prehistorical humanity. He had heard with frequent pangs of resentful regret how already many of the primitive social habits of the Manipuris were being modified by our more direct rule over them: and he would only hope that it might be exercised for the future in such a manner as at least to conserve the archaic artistry—for this was not primitive—of their vernacular industries, particularly of their textile manufactures. The borderings of their robes and scarves, recalled those of ancient Egypt, and Babylonia, and Assyria. But one is always in terror—in ghostly apprehensions—of the exuberant and unabashed Vandalism of the imperial race which broke up into road rollers one of the rarest columns among the architectural relics of the Mo(n)gul period in India; which wantonly blew up the Jodhbai Palace at Futehpur-Sikri; which destroyed the paintings of the Ajanta Caves, by neglecting to keep the wind and rain, and "the moles (lizards) and the bats" out of the caves after breaking through the high heaped vegetable mould, the soft protecting hand of Nature, that for centuries had concealed, and protected, the entrances to them; which, again, through neglect of the copies taken of them by Major Robert Gill, 1824-52, left them to perish at the Crystal Palace in the disastrous fire of 1866; which removed the choicest remains of the Amravati Tope from the banks of the river Kistna to London, and and left them there to corrode in the open yard of Fife House for nearly 20 years, until he [the Chairman] got them transferred to the reverent custody of the British Museum; which recently cut down the avenue of sad cypress trees leading up to the mausoleum ["Taj Mahal"] of Shah Jehan at Agra; and which has now submerged Philæ [see the *Illustrated London News* of last Saturday, 18th March],—in the supersubstantial beauty of its moonlit loveliness of so spiritualising a witchery, one knew not whether it be of heaven or earth. Let us at least conserve Manipur as the Manipuris themselves have made it. In our Indian administration we should never forget that after all his wanderings in search of possibly better conditions of life, Rasselas at last returned gladly and gratefully to his own "happy valley" of Ambara.

Mr. H. LUTTMAN-JOHNSON said the reader of the paper had demonstrated a fact which he (the speaker)

learned a good many years ago, namely, that Manipur was one of the most interesting places on earth. When he first visited Manipur thirty years ago he thought he had never seen anything to compare with it in human interest. It was a crucible in which was to be seen man being stirred up as it were and coming out made. A well-known writer had written a book called "Mankind in the Making." He would advise that gentleman if he wished to see man in the making to go to Manipur. There were to be seen all sorts and conditions of men in their different stages, from the very primitive up to the more or less civilised Manipur. Dr. Grierson, a great philologist, had said that there were 147 different languages in India; he (Mr. Luttman-Johnson) thought there were a great many more himself; but in the hills round Manipur very nearly as many would be found. They were not separate languages from the philologist's point of view, but it would be found one village did not understand the language of the people in the next village. This meant that there must be an enormous number of languages, the development of which it was possible for a philologist to watch. He had taken a special interest in the paper, partly because he had been in Manipur and had served in the north-eastern frontier of India, and partly because the author, when he first went to India, was one of his assistants. Mr. Hodson always had an inquiring turn of mind, and it was very creditable to the Indian Civil Service that so many of its younger members not only devoted themselves to their duties as assistant magistrates and so on, but went out of their way to acquire an accurate knowledge of the districts in which they were stationed. He thought the paper showed that the author had devoted a large amount of time and taken an enormous amount of trouble in acquiring a very accurate knowledge of the languages, the customs and habits of the people among whom he was placed, and in that respect had done credit to the service to which he belonged. His own acquaintance with the people of Manipur was limited to occasional visits, but he knew the Manipurs of our own districts well. When the Burmese invaded Assam, about 1825, they drove out the original Manipuris, who flocked down into the neighbouring districts of Sylhet and Cachar, where they had remained to the present day. The present Manipuris of Sylhet and Cachar stated that the people in the valley of Manipur who had mixed with the hill tribes were not the original Manipuris, and that they themselves were the original race. He was sorry that the author said that the Manipuris in Sylhet and Cachar bore an evil reputation. He (Mr. Luttman-Johnson) saw a good deal of those Manipuris; they were to a certain extent turbulent, but the extraordinary thing was that from the point of view of civilisation they would be picked out from among the Mussulmans and Hindus of that district as the most civilised-looking; and, even when one got to know them, it was astonishing how advanced they were compared to the other people. For instance, the Chairman had mentioned their weaving and clothing. There was nothing among the natives of those districts at all to compare to the art of the Manipuris in weaving and ornamenting their clothes; it was absolutely unique. They were also fairly well-to-do. If the people in those districts were asked how it was the Manipuris were so prosperous, they replied it was because the women worked. Among Mussulmans the women were kept in the background. They did a good deal of work in planting rice, but were not encouraged to work in the same way as the Manipuri women were. For example, they did not go into the bazaar and sell things as Manipuri women did. The latter had acquired a position of freedom and independence which was uncommon in India.

Sir CHARLES CECIL STEVENS, K.C.S.I., said although he had no experience of Manipur, he had had a little experience of comparatively backward tribes on the western side of Bengal, in Chota Nagpur. He noticed several matters which the author had mentioned in which he detected an obvious, though possibly only a superficial, similarity. One thing that was common to some of the tribes of Chota Nagpur was the institution of a bachelors' hall, although the style of architecture was not the same. Another practice which they used to follow was that of jhuming, or burning the trees off the land. When the trees were burned, rice or a poor sort of Indian corn was sown, and also a sort of cucumber, something of the shape of a cocoanut with the husk on, and very nearly as large. The practice of jhuming was discouraged by his predecessor in the Commissionership, Mr. Hewitt, and he did his best to follow that example, because they felt that a time would soon come when the timber would be far too valuable to be dealt with in that way—and so it had proved. The Kol races in Chota Nagpur put up monumental stones, though he could not recall any instances of the systematic arrangement which the author had described. He recollected one such stone in the district of Singhbhum, in the south of Chota Nagpur, which was just upon twelve feet high, but of irregular shape. He also thought he detected in the physiognomy of many of the people a likeness to the physiognomy of some of the Chota Nagpur people. Another point of resemblance seemed to be the comparatively fragile nature of their houses. In Chota Nagpur that was observable the further away one got from head-quarters and from the purely British tracts; it was most marked in those houses which were on the borders of other native States, because property was not so secure there. The rulers were not very tender with their people, and a man who was being troubled by the ruler of his own State could slip away to a neighbouring State if he disliked his surroundings. But in their own districts there was more stability and houses were better.

Sir GEORGE WATT, K.C.I.E. (who presided over the latter part of the proceedings), stated that he went to Manipur in 1882, and remained there for nine or ten months, so that he had a certain knowledge of the country before the time the author went there. Only two or three Europeans had previously visited Manipur. Sir James Johnson was then the Resident, and he went up to join him, partly with the object of acting as medical officer to an expedition which was about to set out to demarcate the frontier, but mainly to explore Manipur as a botanist. He would like to mention one or two facts which he thought might be of interest. Manipur was an exceedingly beautiful little State. From his own knowledge of India he thought perhaps it was the most beautiful part of the whole of the Empire. He had been in Kashmir, in every province of India, and in every hill station, but he knew of no place that was half so beautiful. Not only was it beautiful artistically, owing to the magnificent hills with which it was surrounded, and its lakes and valleys, but it was exceedingly rich in its animals and vegetables. Probably no part of India had such a varied and beautiful flora. On going into Manipur the first thing that struck the traveller was the enormous number of trees with which he was not familiar in other parts of India. Speaking from memory, he believed there were probably twenty species of oak; and there were a great many other trees which were equally beautiful, interesting, and novel. For instance, Manipur was the home of the tea plant. To his mind there was no manner of doubt that the tea plant went from Manipur to China, Manipur being its original home. There were practically forests of tea trees, many of them of considerable height, and with leaves that would astonish anyone who knew what a cultivated tea plant was like. The leaves of the Manipur tea plant were often a foot or more in length. It was a most superb tree when in flower, and was one of the most beautiful trees of nature. Another interesting fact about Manipur was that it was the home of the silk-worm. He believed it highly probable that the real mulberry silk insect originated in Manipur, and from there went into China. There were many other instances of the kind that might be mentioned, showing the extraordinary influence Manipur had exerted on India and China. Manipur had been the half-way house between India and China far beyond historic times. There was one very remarkable feature about the country, namely, that the whole of the vegetation was depressed two or three thousand feet; but the cause of this no one had been able to explain. Taking, for example, plants that were well-known, certain species of rhododendrons that grew in Sikkim at about 14,000 or 15,000 feet, were met with on the north-eastern hills of Manipur abundantly at 7,000 to 9 000 feet. On the border between Manipur and the Naga Hills there were also four or five species of rhododendrons all behaving in the same remarkable way, showing that there was something in the climate of Manipur that was exceedingly peculiar. The whole of the typical plants of Sikkim were in Manipur, but at an altitude considerably below what they were in Sikkim. Then in the valley of Manipur, the peach, pear, and apple trees were cultivated, which would be quite an impossibility in any other part of India at the same altitude. There were also remarkable peculiarities about the animals, so that what the author had mentioned with regard to the extraordinary diversity of the people was only paralleled by the extraordinary diversity of the plants and animals. Every little valley in Manipur had a race of people of its own, a language more or less of its own, and, what was more remarkable still, a flora of its own. For instance, fourteen or fifteen miles away from the town of Manipur, not only was the vegetation entirely different but the rainfall was three or four times as great. Manipur was a land of surprises in every direction, and when he went there he revelled in it because it was so exceedingly interesting. The author had slightly disparaged the women of Manipur. He (Sir G. Watt) was inclined to think that many of them were very pretty. The young girls who sat by the roadside struck him as not at all bad-looking; and when he asked them one or two points on which he wished to be instructed their intelligence and happy natures fairly astonished him. They did their embroidery work without any pattern sketched on the border; they were apparently working without anything to guide them, and yet making those magnificent borders at the bottoms of their skirts which had been shown on the screen. In conclusion, he proposed a very hearty vote of thanks to Mr. Hodson for the exceedingly interesting and beautiful paper which he had given.

The resolution was carried unanimously.

Mr. HODSON, in reply to Mr. Luttman-Johnson's remarks that he had slightly disparaged the Manipuri residents in Cachar and Sylhet, said that if a robbery of any importance ever occurred in those places it was always stated that a Manipuri had done it. In reply to Sir Charles Stevens, he would point out that there were several types of houses. The Naga house was a very strong solid structure, which lasted for a good number of years, whereas the Kuk house was light and fragile, simply because they moved their villages every three years. When he was carrying out the census he had to go through the hills, and he found whole villages on the move. It took the natives about two days to build up a village of fifty houses, so that naturally enough they did not go in for building anything very solid. They also moved their villages for political reasons similar to those Sir Charles Stevens had mentioned. When a chief was powerful and popular, people would move to his village, and so long as that chief lived his village would grow and increase. Directly the chief died the village broke up, and the people went

through the whole process again. Sir George Watt did not mention in his interesting remarks about the fauna of Manipur that there were one or two rare species of birds and deer which were only found in that part of the world. For instance, the deer with the brown antler curving downwards and backwards was extremely rare. The evolutionary theory was that those deer, which were only found on the edges of the swamp, had grown curved antlers in order that they might be able to lift up the top of the swamp so as to browse underneath. There were at least two species of pheasants which were only found in the hills at one particular spot; one species was found in one valley and one in another, and were never known to cross over. That was an inexplicable fact.

Sir GEORGE WATT writes:—When I was called upon suddenly to take part in the discussion on Mr. Hodson's most interesting paper on Manipur, I forgot to mention one half the facts that might have been brought out by me. For example, with certain of the tribes, a plant is regularly cultivated to this day as a source of food that I think Manipur may safely be assumed to have been at least one of the centres of original cultivation. I allude to "Job's tears" (*Coix Lacryma-Jobi*). This is known to the Nagas as "ka-si," but far away in the Central Provinces it is "kesei," so also "kesai" in Guzerat, "kesai" in Berar," "kyeit," "kulese," and "kalinse" in Burma. These similarities one would think can hardly have been accidental, but rather denote knowledge in food-stuff that originated from a circumscribed locality from which also came its name. Now it is a curious coincidence (if that be all) that one of the earliest names for Manipur is "Ka-se," a word that in Burma was pronounced "Ka-the," and which became the Cassay of Dalrymple and other early European writers.

Whether this be a safe deduction or not, there is perhaps no aspect of ethnology that may in the future afford revelations of greater value than the study of the crops grown and plants eaten by aboriginal tribes. I give the example of *Coix* as suggestive only; but it is just possible that the distribution of that grain was conterminous with the invasion and conquest of India by the Mongolians, who crossed the North-East frontier and possibly passed through the little State of Manipur and carried the *Coix* into Assam, Bengal, the Central Provinces, and Burma. It is extensively cultivated to this day by people who are strongly Mongolian.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 5th, 1905; EDWARD WILLIAM BRABROOK, C.B, F.S.A., in the chair.

The following candidates were proposed for election as members of the Society:—

Ababrelton, Robert à, P.O. Box 322, Pietermaritzburg, Natal, South Africa.

Kinch, Walter S., Burtholme, Worthington, near Wigan.

Lucchesi, Andrea C., 2, Camden Studios, Camden-street, N.W.

The following candidates were ballotted for and duly elected members of the Society:—

Flack, Albert, 264, Borough High-street, S.E.

Pierera, A. A., Alexandra Institute, Hyderabad, Deccan, India.

The paper read was—

ANCIENT ARCHITECTURE AT GREAT ZIMBABWE (RHODESIA).

By RICHARD N. HALL, F.R.G.S.,

Part author of "The Ancient Ruins of Rhodesia," and author of "Great Zimbabwe."

I wish to direct attention to what is admitted to be the greatest archæological wonder of the Southern Hemisphere—the ancient temples of the Great Zimbabwe.

This group of prehistoric buildings lies in South-East Africa at over two hundred miles from the shore of the Indian Ocean at Sofala. Its name is derived from *Makuru Zimbabigi*, or "The Great Buildings of Stones," the title applied to these ruins by the native race of Makalanga, or "People of the Sun," who inhabit Mashonaland and the country of the Great Zimbabwe.

Zimbabwe was known to the very early mediæval Arab traders on the Mozambique coasts, who gave descriptions of these ruins to the Portuguese, and in 1552, De Barros made the first recorded mention of their existence.

From mediæval times until 1868 the existence of these buildings appears to have become completely lost sight of. In that year Adam Renders, an elephant hunter, rediscovered the Great Zimbabwe, but so scanty and so highly coloured were the descriptions of these buildings then given that the scientific world looked askance at their discovery.

It was not until 1871, when Dr. Karl Mauch examined these ruins, that their discovery was treated seriously by the archæologists of Europe. It was then ascertained that their discovery by Adam Renders was but a rediscovery of these ruins, and that the archives of the Vatican and of Lisbon contained earlier information concerning them.

In 1891 Mr. Theodore Bent examined the ruins and embodied his report in "The Ruined Cities of Mashonaland." His account is ex-

ceedingly valuable and reliable, but, unfortunately, he only saw the ruins in their buried condition. Later, other writers, including Dr. Schlichter, a German archæologist, and Sir John Willoughby, added further to our knowledge of this group of ruins.

In 1902 I explored the Great Zimbabwe on behalf of the Government of Rhodesia. This work extended over two years, and the report to the Government on my explorations and discoveries is now embodied in "Great Zimbabwe," a volume forming a natural sequence to "The Ancient Ruins of Rhodesia," of which I shared the authorship with the late Mr. Neal.

Since my return to England last autumn I have had opportunities of discussing before leading scientific bodies at home several phases of the Zimbabwe problem, such as the origin of the ruins, the evidences of ancient civilisation and arts, the mediæval and modern records concerning them, and the progress made within recent years in researches regarding these ancient monuments.

Ancient Architecture.

But among the many aspects from which the great Zimbabwe problem may be considered there was one which I had not as yet submitted for discussion, and this was the all-important subject of the architecture and construction of these buildings as represented by the temples at Zimbabwe.

In the consideration of their style of architecture and methods of construction will, in most probability, be found a reliable key to the final solution of the enigma these marvellous structures present to the archæologists. But first it was necessary to bear in mind that the whole of Southern Rhodesia lying between the Zambesi and Limpopo rivers yields abundant evidence that in some prehistoric times the country was occupied by a dense population of colonists, thought to be Semites of South Arabia, who were engaged in a gold-mining industry of almost inconceivable extent, and which represented an occupation extending over very many centuries of time.

Ancient gold mines exist in all the auriferous districts of Southern Rhodesia, covering an area of 600 miles from east to west and 500 miles from north to south. Associated with these ancient gold mines are buildings undoubtedly erected for the main purpose of defence, obviously suggesting by their architectural features and massive construction that these prehistoric colonists occupied by force in a hostile country. Certain of these buildings are now believed to have been erected to serve the further purposes of religious worship and solar and astral observation. Some of these structures evidently were capital centres of gold-mining districts, others protected extensive gold workings, while others are found in chains protecting certain well-defined routes throughout the country and also leading towards the coast.

The Great Zimbabwe, by its evident importance and great extent, was undoubtedly the ancient metropolitan centre for the whole of the country. There are at least five hundred distinct ruins of buildings throughout Southern Rhodesia, and of these descriptions at least two hundred are to hand. These buildings are of all ages and periods extending from prehistoric times down to within the last few centuries. These various classes of ruins present different types of architecture, and yield relics belonging to different periods of antiquity, and generally occupy distinct areas of country. But it is with the most ancient type of buildings, as represented by the Great Zimbabwe, that archæologists are most concerned.

Possible Age of Zimbabwe.

There appears to be unanimity in opinion among many leading scientific men of Britain, Germany, and France, that the age of the Elliptical Temple at Great Zimbabwe, and of the associated ruins of a similar style of architecture and construction, dates back to some period between 1600 and 1100 B.C. This opinion is based on several grounds, some of which may briefly be stated:

1. The striking parallelisms existing between the architecture and plan of the Great Zimbabwe and those at least of two ancient temples in South Arabia, as to the remote antiquity of which latter there is no doubt.

2. The orientation of the three Zimbabwe temples and of some score of other ruins in Rhodesia determined independently by British and German scientists, all point to the probable age of many of the buildings being from 1600 to 1100 B.C.

3. The discovery at Zimbabwe of the zodiacal signs showing the sun in Taurus, which astronomers assert represents a period which could not date later than 1600 B.C.

4. The undoubted practice at Zimbabwe of nature worship of an exceedingly old cult believed to synchronise with that period.

5. The absence from Zimbabwe of all sign-writing, the earliest inscriptions found in any Phœnician temple being not older than 700 B.C.

6. The evidences at Zimbabwe of ancient civilisation and arts whose only parallel in many respects, especially in their associations, is to be found in the ancient kingdoms of south Arabia.

7. The evidences of ancient gold-mining operations, distinct from those of mediæval Arabs and Portuguese, of an inconceivably vast extent, showing a total output of gold in prehistoric times of at least £75,000,000 sterling, which mining operations geologists and mining experts show were conducted at a most remote period well synchronising with the estimated ages of the oldest of the Zimbabwe buildings.

8. The presence throughout Southern Rhodesia, and especially on the ancient mines and ruins area, of trees and plants which are not indigenous to South East Africa, and which still bear their fruit in the early spring. But additional internal evidences from the ruins and mines in Rhodesia could be advanced, also external evidences obtained by scientific research in the Near East, the Mozambique coasts and Madagascar, from ethnological and anthropological examinations, and also from Arab traditions.

With these evidences should also be taken into account the inability of scientific men, and especially of geologists, to point to any country or combination of countries other than Rhodesia, which could have yielded the enormous wealth of gold, which according to ancient Roman and Grecian historians, and the Scriptures, and modern research, was so plentiful in all the ancient empires of the Near East.

Rhodesia, it is now admitted, contains the most extensive ancient gold mines known to the world.

Having suggested in mere outline the probable ages of the Zimbabwes, I will now deal with their appearance, plan, architecture, and construction.

Appearance of Ruins.

Immediately on viewing the great Zimbabwe for the first time every visitor, even the most casual, is greatly impressed by the extraordinary massive proportions of its grandly sweeping walls. Undoubtedly the Elliptical Temple is a most awe-inspiring structure. Its appearance powerfully suggests the Near East.

The European student of architecture, to entertain any adequate idea of the oldest type of forts and temple-forts in Rhodesia, must first dismiss from his mind all conceptions of the distinctive features of Grecian, Roman, and Egyptian styles of architecture.

I was assured by professors and students of Egyptian archæology that the plan, architecture, and construction of Zimbabwe finds absolutely no parallel or similarity with the plan, architecture, and construction of any known Egyptian building. This is obvious to any one visiting Zimbabwe.

In Rhodesia the ancient architecture provides no sculptured columns and ornate capitals, no arches, and no basilica, but conical towers and monoliths enclosed within stupendous walls laid on an elliptical plan—all unroofed from the very date of their construction and all open to the light of heaven.

So far as archæological researches lead the ancient buildings in South Arabia—of Yemen, the ancient empire of Saba, alone present any parallel with those of Zimbabwe, and in several of their most important features of architecture an identity is believed to have been established.

Plan.

The plan on which the oldest of the Zimbabwe buildings throughout Southern Rhodesia are laid is always elliptical. Walls are built on curves, and the ends of walls, sides of entrances and buttresses are rounded. The angular form of building is absent, and is only found in the case of structures of obviously much later periods.

Main Walls.

The walls are very substantially built with bases averaging from 7 feet to 16 feet in width, and are beautifully and most skilfully constructed not only on the exterior faces but in the internal portions. Levelling instruments must have been used at Zimbabwe.

Each wall has a lean-back or batter-back on either face. Thus the main east wall of the Elliptical Temple is 16 feet wide at its base, but at a height of 30 feet its summit is 8 feet in width.

The average batter-back of high walls of the oldest type is one in ten to one in eight, though one in six is often met with in lower walls.

Building Materials.

The building material employed at Zimbabwe is local granite in blocks, with faces averaging nine by seven inches. Many of the

blocks have been rudely squared by the use of diorite hammers, some having been cut with metal tools.

Building Material.—How Obtained.

One might ask how the ancients obtained the enormous quantity of building material. Was it by quarrying in the local hills? I am of opinion that no quarrying, in the ordinary sense in which the word is employed, was carried on by the ancients. All the evidences are strongly to the contrary. Caves occupied by the ancients could have been considerably enlarged and their accommodation greatly increased by simple quarrying operations, but the caves remain in their natural state. Rock protuberances in the floors of some of the ruins have not been removed, but permitted to remain, even to the extent of inconveniencing the occupiers. The hills in the Zimbabwe district show no signs of any quarrying operations on the part of the ancients.

The hills and cliffs which abound round the Zimbabwe valleys are granite. These are mainly whaleback in shape, and layers of granite in some stage of decomposition cover the faces of these hills, and whaleback cliffs with gigantic scales, the layers being about six to nine inches in thickness. At the bases of these hills and cliffs are hundreds of tons of scale rocks or slabs, broken fairly square by their fall from great heights. These are flat top and bottom, and only require slight trimming, if any, on their sides to make them fit closely together, and so form the ordinary block of granite as seen in the walls. These gigantic scales from the faces of the cliffs are always falling, especially after long rains; the roar and crash of these falling masses of slabs can at times be heard from our camp in several directions. No doubt the ancients finding so conveniently situated these extensive masses of fallen scales of rock, almost suiting their purpose without much labour except for their transport for two or three miles only, used these blocks in building, trimming their sides when necessary. Possibly they assisted to loosen these slabs from their original position on the cliffs in order to increase the supply of materials.

The granite used in the walls is all local, but lithologists state that the ruins on Zimbabwe Hill (350 feet), are mainly built with a local granite which does not correspond to the class of granite yielded by the formation constituting the hill itself. We may be assured that the great majority of these blocks in the extensive "Hill Ruins" was carried up to the summit from a distance of two or three miles. This implies an employment of slave labour of great proportions, but the ruins elsewhere as well as the ancient gold mines all point unmistakeably to the same conclusion. At least over 100 tons of slate used in the buildings have been carried from a distance of ten or twelve miles, the nearest point of the slate formation to Zimbabwe being about ten miles.

The soapstone extensively found at Zimbabwe must have been imported from a distance of twelve or twenty miles, that being the nearest soapstone formation to Zimbabwe. The huge granite monoliths are believed to have been carried by slaves from the Lumbo district some two miles distant. Each of these would have required an immense number of slaves even to lift it from the ground.

Dry Masonry.

No cement or mortar has been used in the construction of the walls, all these being of dry masonry. The ancients extensively employed a fine granite cement for floorings, steps, and dadoes. In their more important dado work, the dadoes have had an outer layer of whitish soapstone clay brought to a high polish.

Passages.

One extraordinary feature at Great Zimbabwe is the extent and number of passages, amounting, so far as they have been discovered, to a length of over 5,000 feet, of which over 2,000 feet in length were discovered during the recent explorations. The heights of the side walls are from five feet to thirty feet, while some are sunk below the level of the ground. All are very narrow, some being only shoulders' wide.

Each temple has an important passage; these are conjectured to have been the approach of the priests to the inner shrines or sacred enclosures. The lowest floors of these passages yielded great quantities of religious emblems and articles of gold.

At Zimbabwe the ancient architects laid down a splendid system of drainage, which must have been contemplated before the outer main walls were erected. The buildings were open and never roofed, but by this system the flooding of the temple during sub-tropical rains was prevented.

[Mr. Hall then proceeded to describe with the aid of lantern views the conical towers, platforms, mono-

liths, carved stone birds, and mural decorations found at Zimbabwe, and the various periods and styles of construction and successive occupations of these ruins.]

DISCUSSION.

The CHAIRMAN, in proposing a vote of thanks to the reader of the paper, said he had admirably described the altogether unique remains which had been excavated with so much skill and patience. It was a very curious circumstance that the period referred to of something between 3,000 and 4,000 years ago was a time at which, in many parts of the world, a great deal of knowledge and attention seemed to have been given to astronomy, and proficiency in art and mechanical appliances, and that there were, dating more or less back to that period, in many parts of the world, monolithic and other remains of great magnitude, which caused the envy of modern people in their endeavour to imagine how they were brought together. Among those remains there were few more startling than those which the author had described. The beauty of the curvilinear form, the ease with which simple devices for adornment had been adopted, and the taste of the whole of the features of the remains were exceedingly striking. The labour which must have been necessary to collect together such massive structures as the solid buttresses and conical towers was enormous. The subject had been described in the most lucid manner by the man to whom great credit was due for having done the work, and it had been illustrated with a splendid collection of lantern slides, in which the scale of the immense structures was shown by workmen engaged in the operations being included in the photographs. The great buildings in the Acropolis were even more startling than those in the Elliptical Temple, because of the immense difficulty which must have been experienced in building them up to their great height. The paper had also encouraged the feeling, which was now so common in regard to most things, that the old was better; that whenever really good work was found, in which every stone was laid with absolute precision, and in which the curves were beautifully arranged, it was the older work, and that the clumsy and loose work was the more modern. It seemed at first sight to contradict the expectations of some people that things were improving as time went on, but it undoubtedly was the case with regard to any kind of art which had been brought to great perfection in ancient times, that when subsequent alterations were found they were very inferior.

Mr. RICARDE-SEAVER said that although he had not been to Zimbabwe he knew a good deal about it, the first he heard of the interesting ruins there being from his old friend, the late Mr. Cecil Rhodes, who showed him some of the wonderful birds which were discovered there. In his subsequent trip to Egypt, the late Mr. Rhodes endeavoured to find similar birds, but was not successful in his search. Mr. Rhodes spent a good deal of time and money in connection with the remains at Zimbabwe, but during his lifetime very little of real value or interest was found. Although Mr. Bent and Mr. Swan had done very good work at Zimbabwe, he thought the author, and Mr. Franklin White, were to be thanked for elucidating many of the problems which appeared at the time of Mr. Bent's visit to be entirely obscure. He had no doubt that if the author returned to Zimbabwe, and if there was further exploration work to be done, he would on a future occasion place some more interesting data and information before the members.

The CHAIRMAN said he believed those who went to the meeting of the British Association in South Africa later in the year would have the opportunity, if they cared to avail themselves of it, of visiting the ruins at Zimbabwe, and of being conducted over them by Mr. Hall, and this would certainly be not the least of the attractions of that memorable visit.

The resolution of thanks having been carried unanimously,

Mr. HALL, in reply, thanked the members for the vote and also for the sympathetic attention they had given to his paper. He would have liked to have made the subject more popular, but as he anticipated a discussion he restricted the description of the ruins. Nobody had attempted to answer the question as to who the ancient architects were. There was no doubt, both from the ruins themselves and from the mines, that the architecture was not evolved in the country, but introduced in its best forms. The mines also showed that mining on a large scale with shafts was introduced direct into the country and not evolved. There were also evidences that the country had routes, some leading direct to and near the coast. One route, about 200 miles in length, was defended at every four, six, eight, or ten miles by forts, especially in ravines and gorges, and at river drifts. He thought that showed that the people were colonists, the fortifications proving that the people were occupying a country where force and defence were necessary. The knowledge of solar and astral matters pertained to all the Semitic nations of the Near East. Babylon gave the world the signs of the Zodiac. Those old Semitic nations of Mesopotamia, Chaldæa, Phœnicia, Canaan, Arabia, and Babylon, had a profound knowledge of astronomy, and it was doubtful whether we now possesssed the knowledge that those ancients once had. In the temple it was conjectured that some principles of mensuration and geometry were employed. The old Semitic nations had given to the world not only the signs of the

Zodiac, but the foundations for Mercator's sailing tables, its knowledge of astronomy, and even the terms used in the navy, such as admiral, dinghy, prow, and a score of others; and it was a country so highly civilised that it gave the basis of the Phœnician language, which was the mother of all European systems. He did not think there was any doubt that the old nation of the Sabæans were, according to the Scriptures, ancient Grecian and Roman historians, and modern research writers, the gold purveyors of the then-known world. Ezekiel said, "The merchants of Saba were thy merchants; they occupied all thy markets with gold;" and the Psalmist said, "The Kings of Saba shall offer gifts, and unto him shall be given of the gold of Saba." That indicated that, in the Hebrew mind at any rate, the old Sabæans represented the highest ideal of wealth in gold. They had not yet explained what had become of the gold in the country, unless they attributed its extraction to the old Sabæans, who were known to have had colonies throughout the whole length of East Africa, and who had a monopoly of trade in the Indian Ocean. He would have liked to have heard some discussion on that point, on which he was merely a learner.

Mr. R. Phené Spiers writes:—Whilst willing to bear testimony to the admirable construction of the walls as shown in Mr. Hall's magnificent slides, I am unable to admit that the title of architecture can be correctly applied (as we understand the term) to the buildings of the great Zimbabwe. The question of stone walls in circular or elliptical forms, with raking sides and rounded angles is not architecture, in fact, the Zimbabwe construction never seems to have gone beyond its first elementary creative stage. Mr. Hall referred, however, to three decorative patterns, which he said are among the earliest ever adopted, these being the *herring-bone* pattern, the *dentelle*, and the *chevron*. The first, however, is not a pattern at all: it is only a method of laying masonry or brickwork. When the material is of thin dimensions, as is the case with tiles or slates, it is found easier to lay it in sloping courses, but *in order to make it sound construction, these tiles, slates, or thin courses of stone must be embedded in mortar*, and as the builders of Zimbabwe never used mortar, it is evident they never built herring-bone masonry. There was only one instance in which it had been found on the upper part of a wall, and from its appearance in the photograph, this was probably a late addition, and could not be called a pattern any more than the ordinary cresting of an English wall. *Dentelle* is the French for lace, and as evidently that is not meant, the word is probably a corruption of the word *dentil*, which is a well-known architectural term applied to the imitation in stone of the ends of squared timbers which project in front of an architrave or beam to carry a roof. But the projections shown in the slides are those employed when blocks of stone are placed edgewise on the top of a wall carrying slabs of stone straight in advance of the wall beneath. This is a type of finish to a wall which was largely employed by the Sassanians, and when, as in one of their later works at Rabboth Ammon, they employed this same indentation round an arch, it bore the closest resemblance to what is known to us as the dog-tooth ornament, which is so largely found in Norman work. The "dog-tooth course" would be, therefore, a better term to employ. But on the western temple platform in the acropolis a photograph was shown of a series of vertical indented shafts, incorrectly termed columns, built in coursed masonry. These appeared to be about 20 feet high, but, if I understand correctly Mr. Hall's description, they measure only 3 feet 6 inches high. They may have been enclosed with a border, and constituted a panel decoration only. The chevrons of the exterior face of the south-east wall are an admirable termination of the same, and it would have been difficult to conceive a more happy design than this, which gives dignity and scale to what is certainly a magnificent wall. Whilst differing from Mr. Hall as to the title of architecture which he claims for the Zimbabwe constructions, and to a certain extent to the nomenclature applied to the patterns, I beg to bear testimony to the great interest of the researches which he has undertaken. They give architectural value to those made some years ago by Mr. Bent, though Mr. Bent's work settled many problems respecting which there was some doubt.

MOTOR VEHICLES.

The motor car would have been a familiar object generations ago but for the sustained opposition of local authorities and those whose interests related to horse haulage. Invented towards the close of the eighteenth century, and pronounced perfectly practicable by a Parliamentary Committee of 1832, in 1834 a motor car attained a speed of 34 miles an hour, and ran long distances at an average of 24 miles an hour. For the first forty years of last century the contest between rail and road locomotives was strenuous and the result doubtful, but after 1840 there was a temporary cessation in the manufacture of road cars. It was not until 1857 that practical men took them up again, believing that they could be worked with great advantage to the community. Then Parliament intervened.

In 1859 a Bill was introduced imposing heavy tolls upon motor carriages. It was referred to a Select Committee and fell through, but in 1861 an Act was passed which, among other restrictions, prohibited motor carriages being propelled at a greater speed than ten miles an hour in the country and five miles an hour in towns. But inventors were not dis-

couraged, and by 1865 many improvements had been made in the machines. Then Parliament dealt a crushing blow, prescribing in an Act of that year that each locomotive should be conducted by three persons, that the maximum speed should be four miles in the country and two in towns, and that it should be forbidden even to blow off steam. Power was also given to the local authority—usually hostile—to fix the hours during which the machine might be used. In 1878 the same authority was enabled to make by-laws and to charge a fee not exceeding £10 for a license to use motor carriages. These Acts were created to deal with heavy traction, but in 1881 the Court of Queen's Bench placed every type of self-propelled vehicle under the limitations indicated.

Hitherto motor carriages had been propelled by steam alone, but now gas engines were invented and petroleum engines proposed. Thereupon Parliament set itself to make it difficult to try these new powers, and did so by widening the Acts which hitherto had only applied to steam engines. Thus, in the Act of 1878 a locomotive was defined as "a locomotive propelled by steam, or by other than animal power." Nor were the county authorities more disposed than Parliament to welcome the motor car. In 26 counties the full license fee of £10 was demanded. In only six was the fee as low as £6. If a person travelled in a motor car from London to Newcastle he had to take out nine several licenses, and they cost him £85. It took him a week at least over the journey, not because his machine would not go quicker, but because the by-laws regulating the traffic were seldom alike in any two counties. It was necessary for him to get nine sets of these by-laws since he had to cross nine counties, and his groom had to walk in front of him the whole way with a red flag.

The inevitable result followed. From 1878 onwards for many years inventors were confined to the manufacture of heavy locomotives. In 1881 Sir Thomas Parkyn caused a steam tricycle to be constructed, but he was immediately prosecuted although his machine emitted no steam, and made so little noise that the policeman who gave evidence respecting it was doubtful how it was driven. The magistrates were bound to enforce the law, and the sentence was ratified on appeal. Parliament, local authorities, courts of law, all seemed combined to throttle one of the most useful inventions of the age, with the result that this country was left behind in mechanical traction by France, Germany, and the United States, whose agencies were handicapped by no such restrictions.

It was not until 1896 that Parliament was persuaded to take a more friendly view of motor cars. The chief prohibitory clauses of the Acts named above were then repealed and the Locomotives on Highways Act of that year first gave motorists the right to drive motors on the public roads. This Act was considerably modified and amended in the motor interest by the Motor Car Act of 1903, which came into force at the beginning of 1904. This Act prescribes the speed at which motors may be driven, prohibiting a greater speed than 20 miles in the country, or more than 10 within any limits or place referred to in the regulations made by the Local Government Board. The provisions of the Act are too well known to need recapitulation here, but it may be said that motorists have no longer reasonable ground of complaint against the Legislature.

The change in the attitude of Parliament towards the motor-car was quickly followed by an immense development of the motor industry, which shows no signs of slackening. France still leads the way but England is no longer discreditably behind continental nations, and, indeed, a British motor car now holds the world's record for speed, and what is of equal consequence, reliability. In all directions the motor is revolutionising practice. The Prime Minister has given it as his opinion that it will solve the housing problem by carrying the workman into the country at a cost within his means. But that time is not yet. It can hardly be said that prices are on the down grade. The average value of the car now manufactured is lower than it was two or three years ago, but this is due to the introduction of a lighter vehicle. The exhibitors have plenty of motors ranging in price from £500 to £1,500, bulky and luxuriously appointed machines averaging from 20 to 35 horse-power each. But the Trade is also putting on the market patterns which can be sold at much lower figures. It is quite possible to get a machine for £100, but rather curiously there is no demand for it; the lowest priced machine for which there is any sale costing £125. Petrol, steam, and electricity are the power agents in use, but electricity is practically confined to town vehicles, the public seem to distrust steam, and for the present petrol is almost universally used.

There is certain to be a large increase in the number of motor cars and machines in use in the near future. To give a single indication as to cabs, the London Express Motor Service, Limited, has just ordered from the Herald Manufacturing Company of Manchester 100 hansom cabs, and many hansom cabmen are attending classes on automobile management and driving. The omnibus question is a much larger and more contentious one. It is claimed for the motor omnibus that it is more convenient for the public and likely to be more profitable to shareholders than the electrical tramway. It is a very complicated question which cannot be gone into now, but it is safe to say that motor omnibuses have come to stay, that for many suburban districts, for sparse populations, and for narrow streets they are better than trams, that in the City, where trams are impossible, they will be a boon, and that many of the smaller provincial towns will regret that they are tied to tramways. It may be noticed in this connection that last month the Wolverhampton Tramways Committee decided not to lay down a tramway to Renn Fields but to serve the locality by means of motor omnibuses.

Motor cars are beginning to be used very largely for agricultural purposes. If a farm is to pay in these days there must be efficiency and economy in its management, and motors have now been brought within the reach of the man farming on a moderate scale, whilst in cases where half-a-dozen small farms are near enough to each other informal syndicates have been formed for the purpose of purchasing a motor machine for all round work, to be used by all in turn, and they are proving a magnificent investment. The motor can do pretty well everything on a farm, except pick fruit and clip hedges. Nearly everything in the way of cultivation and harvesting can be done by it at a saving of from 30 to 50 per cent. And so with railways. Already the motor is of great advantage to them as feeders. The North Eastern Railway Company was the pioneer in this direction. In 1903 it introduced motor cars on two lines included in its system, the first between the Hartlepool and the West Hartlepool Stations, which at once became a success. In October of the same year a motor car service was inaugurated by the Great Western Railway Company between Chalford and Stonehouse, a distance of a little over six miles, which was covered at hourly intervals, with six intermediate stops, in 23 minutes, the fare being a penny a mile. This was followed by the London, Brighton and South Coast Railway Company running a service between Brighton and Newhaven across the sea front of the South Downs, a picturesque and breezy drive of nine miles; and now in all directions we see the railway companies feeding, or preparing to feed, their systems by motor carriage. As for cartage the horse is hopelessly distanced. A leading manufacturer gives the following illustration. One wagon on building contractors' work carts brick, cement, general joinery, &c., making four journeys per day, a distance of $3\frac{1}{2}$ miles, with an average load of $5\frac{1}{4}$ tons, returning $3\frac{1}{2}$ miles light each journey, for two weeks $5\frac{1}{2}$ days each, and two weeks 5 days each, two half days per fortnight taken for cleaning, &c., a total of 21 days, giving a ton mileage of $1{,}533\frac{1}{2}$, and 294 light miles, the total cost, including interest on £550 at 5 per cent. for one month working out at £23 9s. 4d., or 3·6d. per ton mile $\times$ $3\frac{1}{2}$ miles, $=$ 12·6d. per ton per journey, against the lowest cartage rates by horses available for the same work of 2s. 3d. per ton, thus giving a balance of 1s. 2d. per ton in favour of the motor wagon.

During the last two or three years there has been a striking increase in the number of motors used for municipal purposes. Hindered at the outset by the police, who made trouble as to the height and width of the vehicles, and then by the Local Government Board asking that locomotives on the highway weighing over two tons should not exceed a speed of five miles—it has since been increased to eight—motors are now being used for dust collecting, street cleaning, and watering, and in other ways, and are rapidly ousting the Corporation horse. "The three hundred weight hammers of the horse," says Mr. Higgins, the Borough Surveyor of Chelsea, "wore out the roads at least twice as quickly as the vehicle he drew, required an army of scavengers in turn to wait on him, and was largely responsible for the house-fly pest." When kept constantly at work with the minimum of time occupied in collecting and loading, the motor is not only cheaper than horse service, it causes much less wear and tear of roads than horses.

The Post Office authorities are not generally credited with any great partiality for innovation, but they have done all in their power to encourage inventors to produce a motor suitable for the carriage of mails. For three or four years past they have used motor vans as letter carriers, and their motor service is being rapidly extended. Reliability is the first condition of everything connected with Post Office work, and there is a big fortune for the firm that first turns out a motor van that fully meets the stringent conditions of the Department. The canal companies are among the slowest to adopt the motor as a substitute for canal-barge propulsion, and consequently, except in a few cases where steam tugs are employed, the barges on the canals of Great Britain are still horse-drawn, but they are not likely to remain so. In Belgium, France, and other countries where up-to-date ideas, if they are good, are more quickly adopted, the canal owners better appreciate the motor. Thus, on the Nivernais canal, which extends for over 100 miles, between the Loire and the Yonne, in France, there is a motor barge "length" of $2\frac{1}{2}$ miles on which a Florat motor successfully and easily drags heavy trains of barges at a much greater speed than a horse would travel, and with heavier loads.

THE DECAY OF THE CHICORY INDUSTRY.

Efforts are being made by Yorkshire growers to induce the Chancellor of the Exchequer to readjust the methods of charging the Excise and Customs duties upon chicory. Fifty years ago the production of chicory, for mixing with coffee, was a rural industry of some importance in certain districts of Yorkshire and other counties of England, but during the past thirty years the home-grown supply of this article has, with occasional fluctuations, gradually diminished until it has become a negligible quantity in the produce markets of this country. At one time chicory was grown and dried on farms not only in Yorkshire, but also, on a smaller scale, in Nottinghamshire, Lincolnshire, and Cambridgeshire, and the industry is said to have yielded large profits, and to have given employment to a considerable number of men, women, and children. The development of this rural industry prior to 1853 was, however, favoured by fiscal conditions, inasmuch as imported raw or kiln-dried chicory was subjected to a Customs

duty of 20s. per cwt., and there was no Excise duty on the home-grown article. In 1853, Mr. Gladstone reduced the duty on foreign chicory to 4s. per cwt., and entirely abolished it in 1854, from which date until February, 1860, imported raw or kiln-dried chicory was allowed to come in free.

The withdrawal of the duty on foreign chicory was a blow to the growers in this country, and they had hardly adjusted themselves to the new conditions of competition when the industry was again disorganised by the imposition of an Excise duty, the actual amount of which was less disturbing than the regulations connected with its collection at the country kilns. This duty was first imposed in 1860 when home-grown chicory was charged at the rate of 3s. per cwt. Next year it was raised to 8s. 6d., and in 1862 to 11s. The Customs duty in 1860 was 6s. per cwt., and in 1861 and 1862 it was 12s. In 1864 the Excise duty was fixed at 24s. 3d. per cwt. on home-grown chicory, and at the same time a Customs duty of 26s. 6d. per cwt. was placed on the imported article. In 1872, when the coffee duty was reduced by 50 per cent. the rates on home-grown and imported raw or kiln-dried chicory were fixed at 12s. 1d. and 13s. 3d. respectively, and have since remained at these levels.

The imposition of an Excise duty checked the sowing of chicory, and after the readjustment of the duties in 1872 the home production steadily declined. The farmers' kilns were eventually dismantled and devoted to other purposes, and the drying of the roots became a monopoly in the hands of the merchants, to whom the few farmers who still continue to grow chicory have for some years sold their roots in a raw state. The largest quantity brought to charge before the change in the duties in 1872 was 20,611 cwts. in 1866-7. At that period the area under the crop in Great Britain was approximately 600 acres, of which 400 and 500 acres were situated in the neighbourhood of York. The crop was abandoned in Northamptonshire in 1871.

The use of chicory in this country seems to have steadily diminished. Thus in the year of largest production, 1866-67, while the quantity of home-grown chicory on which duty was paid was, as has been stated, 20,611 cwts., the foreign chicory entered for consumption, raw or kiln dried, was 83,941 cwts., making a total of 104,552 cwts. But although in 1903 the home production had fallen to 1,674 cwts., the foreign importation was only 76,926 cwts., reducing the total to 78,600 cwts., and this in face of an immense increase in population. In 1895 the area devoted to the crop in Belgium was 929,976 acres; it has since declined to 16,843 acres.

It is complained by the growers of chicory that there are certain differences in the methods of collecting the Excise and Customs duties on chicory that operate to the disadvantage of the home industry. The Excise duty is collected on the kiln-dried chicory, and charged on its weight as removed from warehouse for roasting. The Customs duty is collected on the landing weight of the imported chicory. The British grower has to dry and store his roots under Excise regulations, whereas his Belgian competitor is free from any restrictions of this kind. In compensation for this disadvantage there is a difference of 1s. 2d. per cwt. between the rates of Excise and Customs duties in favour of the home-grown product. But the compensation is said to be insufficient for various reasons. (1). Difference in assessing the Excise and Customs duties. In Yorkshire it is the custom to dry the chicory on the kilns for 24 hours, at the expiration of which it is weighed off and removed into warehouse under the supervision of the Revenue officers. By this process of drying the root loses almost exactly 75 per cent. of its weight, so that a ton of cut root yields approximately 5 cwts. of dried chicory. The duty of Excise is charged, however, not on the weight of the article as removed from the kiln, but on the quantity weighed out of warehouse. In the warehouse the chicory, which frequently lies there several months, absorbs a certain amount of moisture from the atmosphere, and by assessing the duty on the weight of the article on its removal from warehouse instead of on its weight when deposited in warehouse the Excise charge on the accumulated moisture. The Customs, on the other hand, charge the duty on the landing weight of the imported chicory, even when the article is deposited in warehouse, so that the foreign article bears no excess duty from moisture accumulated in bond. (2) Most of the kiln-dried chicory exported from Belgium is subjected to a second drying immediately before shipment, which is known as "high-drying," which reduces its weight by about 20 per cent., so that each hundredweight of Belgian "white-dried" chicory, which would have paid 13s. 3d. in duty before being "high-dried," actually pays when imported in the "high-dried" state about 10s. 8d. If these figures are compared with the Excise duty of 12s. 1d. on Yorkshire "white-dried" chicory, it will be seen that by purchasing the "high-dried" imported article, the roaster in this country saves 1s. 5d. per cwt., or 28s. 4d. per ton in duty alone. In this way not only is the margin of 1s. 2d. per cwt. between the Excise and Customs duties swept away, but there is a gain of 1s. 5d. on every cwt. of imported "high-dried" chicory used in preference to the home-grown product.

It is now being urged that so long as Belgian "high-dried" chicory is allowed to pass the duty as kiln-dried at 13s. 3d. per cwt., the duty on the "white-dried" home product should be so modified as to remove the disproportionate charge it at present bears in relation to the duty imposed on the imported "high-dried" article. This system would seem to have the support of Mr. Crawford, whose exhaustive and authoritative "Report on the cultivation and drying of chicory in Great Britain" (Cd. 2,169) should be read by all interested in the subject.

CORRESPONDENCE.

BRITISH WOODLANDS.

Sir Dietrich Brandis points out that two passages in his remarks in the discussion on Sir Herbert Maxwell's paper, printed on page 540, col. 2, should stand as follows:—

Lines 10-14: "It is difficult to obtain the financial results of forest management in private estates, and this is one of the reasons why private proprietors do not take up the question."

Lines 32-36: "In connection with rabbits, the speaker desired to say that in some enclosures of Richmond-park he hoped now to see young oaks coming up from self-sown seed, which would have been impossible while millions of rabbits were there."

Dr. John Nisbet writes:—

It would have given me great pleasure to have been present at the reading of Sir Herbert Maxwell's excellent paper on "British Woodlands," on 29th March, and to have made a few remarks in support of its main proposals.

When Mr. Hutchins's paper on "National Forestry" was read during the session 1899-1900, I pointed out that any vast scheme of national planting, as therein recommended, was entirely out of the question (even in the very improbable case that funds might become available) and that technical instruction in forestry must be the first step towards improvement, and any ultimate prospect of planting for profit on an extensive scale. Partly as the result of the Forestry Committee's report in 1902, much has been done, both privately and by Government, to provide adequate instruction at different educational centres, and further results are pretty certain to be noticeable in the near future. But technical instruction alone will not solve the problem of planting waste land extensively with profit, and of helping to provide supplies of home-grown timber for future use.

If there is ever to be any great scheme of planting in the United Kingdom it must be undertaken by the State, and if it be desired to induce landowners to plant with a view to profit, then it is certainly the primary duty of the State to provide (1) a practical object-lesson as to how to plant waste land with profit, and also (2) to provide landowners with reasonable inducements to plant, partly in the way of providing easements from existing burdens falling on plantations, and partly in assisting them to obtain the necessary funds on easy terms that would not press unduly on the life-interest enjoyed in the estate by the present landowner.

To discuss any of these latter points would be quite beyond the purpose of my present remarks; but as regards the planting of waste land, I very cordially support Sir Herbert Maxwell's recommendation that the State should acquire 1,000 acres (and far more than that when they are about it) and plant it on business principles, and on a well-considered scheme. In fifteen to twenty years this could provide the much-wanted object-lesson of how to plant waste land with profit; and after the total loss of £10,000 on the recent absolute failure of the Knockboy Plantations in one of the congested districts of Ireland, the duty of the State to furnish some such object-lesson has become all the more imperative. This is far more necessary than the purchase of woodlands (as recommended by the Forestry Committee, 1902) in connection with technical instruction.

Sir Herbert's estimate of £6 an acre all round seems a very fair one; and it would even cost much less than that if the land happened to have good natural drainage and a light soil, where the cheap method of notching could be employed. No doubt about £7 an acre would in most cases completely cover all outlay for draining, fencing, clearing and preparing the ground, planting, and beating up blanks in the first two years till the plantations can be considered established. Fencing, a very expensive item in small plantations, decreases rapidly per acre when planting is done in extensive blocks. Thus, for fencing in squares at 6d. per trimming yard, the total and proportional expense varies as follows:—

Area, acres.	Total yards of fence.	Total cost of fence.	Average cost per acre.	
		£	s.	d.
1	280	7	140	0
4	560	14	70	0
16	1,120	28	35	0
64	2,240	56	17	6
256	4,480	112	8	9
1,024	8,960	224	4	4½
4,096	17,920	448	2	2¼

With regard to future forecasts of the value of the timber crops, I venture on no remarks. The timber prices of the future are likely to be far higher than they are now, or than they ever have been; but they are too uncertain to form any suitable basis for an actuarial calculation. No doubt the relative value of different kinds of timber will alter considerably. When one can for about 4d. a cubic foot impregnate comparatively low-priced woods like pine, spruce, silver fir, beech, birch, poplar, &c., with creosote, naphthaline, or saccharine substance, so as to render them far more durable than unprocessed larch or oak, then certainly, for outdoor work at least, this tends to equalise the future market value of these different classes of wood; and the economic question then becomes one in which the total bulk of the crop is of perhaps equal importance with, or even greater than, the value of the product per cubic foot. Actuarial forecasts are, therefore, things to fight shy of.

On one point I do not altogether agree with Sir Herbert Maxwell. The Continental and Scandi-

navian winds may blow as violently as—or even more violently than, so far as that is concerned—the storms that sweep over our islands; but we are exposed to violent gales from every point of the compass to a far greater extent than Continental countries.

"Our own periodical losses in the British Isles are heavy every ten or twelve years; while in Germany it is calculated that, at a low estimate, windfalls average about 1,225,000 cubic feet annually. The most destructive storms recorded there during the last fifty years took place in December, 1868 (when over 245,000,000 cubic feet were thrown), in October, 1870 (when over 390,000,000 cubic feet were thrown), in March, 1876 (over 154.000,000 cubic feet), in February, 1894 (over 105,000,000 cubic feet), and on 31st January and 1st February, 1902 (over 58,000,000 cubic feet)."

But at the same time our generally wind-swept and totally unprotected waste land will be very hard to plant with profit until a sufficiency of broad shelter belts or plantations can provide shelter for growing new plantations more extensively.

In respect of the planting of waste land and of the amount of employment woodlands afford to rural labour, the latter being a point particularly referred to by Sir Herbert Maxwell, it may prove of interest to the members of your Society to know what importance foreign Governments attach to national work of this special kind.

Cimiez, Nice, 1st April, 1905.

[Dr. Nisbet refers to some "Notes on Continental Forestry," prepared by him for the "Transactions of the Royal Scottish Arboricultural Society, 1905" for the information mentioned in the last paragraph.]

OBITUARY.

WILLIAM PAUL.—Mr. Paul, the eminent horticulturist of Waltham-cross, died on the 31st ult., in the 83rd year of his age. He was elected a member of the Society of Arts in 1880, and in April, 1889, he read a paper before the Society on "Fruit Culture for Profit in the Open Air in England." He was associated with Robert Fortune in the introduction of the tea plant into India. As a practical cultivator of flowers he was best known by the many new and improved forms of roses which he brought into existence. His work, "The Rose Garden," was first published in 1848, and the latest edition—the tenth—is an exhaustive treatise on the subject. Mr. Paul was the founder of the Royal Nurseries at Waltham-cross, which enjoy a wide reputation. Members will remember the charming exhibitions of roses which were arranged by Mr. Paul for the Society's conversazioni in the Botanic Gardens.

THE HON. SIR DAVID TENNANT, K.C.M.G.—Sir David Tennant died on 29th ult. at his residence, 39, Hyde Park-gate, aged 76. He was for 30 years a member of the Legislative Assembly, Cape Colony, and was Speaker from 1874 until 1896, when he came to London to assume the duties of Agent-General of the colony, a position which he continued to hold until 1902. He was closely identified with the educational life of Cape Colony, and was for some time chairman of the council of the South African College and a member of the University council. He was knighted in 1877, and created a K.C.M.G. in 1892. Sir David was a member of the Society of Arts since 1897. He was a Member of the Committee of the Colonial Section, and presided at one of its meetings in 1899.

WALTER MORESBY CHINNERY, J.P.—Mr. Chinnery, a well-known member of the Stock Exchange, and president of the London Athletic Club, died on the 29th ult. at his residence, Hatchford-park, Cobham. He was born in 1843, educated at Eton, and became a distinguished athlete, winning the Mile and Four Mile Amateur Championship in 1868 and 1869. He was Deputy-Lieutenant of Surrey, and had recently been elected High Sheriff. He became a member of the Society of Arts in 1904.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

APRIL 12.—"The Industrial Resources of the State of Matto Grosso, Brazil." By GEORGE TORRANCE MILNE, F.R.G.S. COLONEL GEORGE EARL CHURCH, F.R.G.S., will preside.

MAY 3.—"Recent Excavations in Rome." By MRS. BURTON-BROWN.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A.

MAY 18.—"Plague in India." By CHARLES CREIGHTON, M.D.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MAY 2, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 10...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (James Forrest Lecture) Col. Rookes Evelyn Bell Crompton, "Unsolved Problems in Electrical Engineering."

Surveyors, 12, Great George-street, S.W., 4 p.m. Mr. H. M. Cautley, "Farm Buildings."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, APRIL 11...United Service Institution, Whitehall, S.W., 3 p.m. Col. The Right Hon. Sir J. H. A. Macdonald (Lord Kingsburgh), "The Volunteer in 1905."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Mr. Percival Landon, "Tibet." (Lecture II.)

National Service League, Caxton-hall, Westminster, S.W., 5½ p.m. Lord Newton, "The National and Imperial Advantages of Universal, Naval and Military Training."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. William Marriott, "The Maintenance and Strengthening of Early Iron Bridges."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Sir Frederick Pollock, "Imperial Organisation."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. T. J. Powell, "Retarded Potatoes."

WEDNESDAY, APRIL 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. G. T. Milne, "The Industrial Resources of the State of Matto Grosso, Brazil."

Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 noon. 1. Address by the Chairman, The Right Hon. the Earl of Glasgow. 2 Mr. W. E. Smith, "The Design of the Antarctic Exploration Vessel *Discovery*." 3. Colonel N. Soliani, "The Armoured Cruisers *Kasuga* and *Nisshin* of the Imperial Japanese Navy." 4. Mr. Herbert Rowell, "The Russian Volunteer Fleet."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. Marcus B. Huish, "England's Appreciation of Japanese Art."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, APRIL 13...United Service Institution, Whitehall, S.W., 3 p.m. Col. H. Le Roy-Lewis, "The Yeomanry in 1905."

Mining and Metallurgy, Geological Society's Rooms, Burlington-house, W., 8 p.m. 1. Mr. Gustav Köller, "The Kedabeg Copper Mines." 2. Mr. T. Kirke Rose, "Refining Gold Bullion and Cyanide Precipitates with Oxygen Gas." 3. Mr George M. Douglas, "Wood Gas for Power Purposes and Gas Generator." 4. Mr. Philip Poore, "Notes on the Prestea District—Gold Coast Colony." 5. Mr. R. O. Ahlers, "Notes on the New Dharwar Gold Field of India." 6. Mr. James Park, "The Cause of Segregation in some Igneous Magmas."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. R. Meldola, "Synthetic Chemistry." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1 Discussion on Mr. Duddell's Report on the International Electrical Congress at St. Louis. 2. Mr. F. Creedy, "The Alternating Current Series Motor."

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

East India Association, Caxton Hall, Westminster, S.W., 4 p.m. Shaikh Abdul Qadir, "The Future of the Hisdustani Language and Literature."

Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 o'clock. 1. Prof. J. H. Biles, "The Strength of Ships, with Special Reference to Experiments and Calculations made upon H.M.S. *Wolf*." 2. Mr. F. H. Alexander, "The Influence of the Proportions and Form of Ships upon their Longitudinal Bending Moments among Waves." 3. Mr. J. Bruhn, "Some Experiments on Structural Arrangements in Ships." 7½ p.m. 1. Mr. R. E. Froude, "Model Experiments on Hollow versus Straight Lines." 2. Mr. C. E. Stromeyer, "The Effect of Acceleration on Ship Resistance." 3. Mr. A. W. Johns, "The Effect of Motion ahead on the Rolling of Ships." 4. Herr S. Popper, "Some Results of Model Experiments in Deep and in Shallow Water."

FRIDAY, APRIL 14...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 o'clock. 1. Mr. A. E. Seaton, "Margins and Factors of Safety, and their Influence on Marine Designs." 2. Mr. J. H. Heck, "Notes on the Variation of Angular Velocity in the Shafting of Marine Engines." 3. Mr. A. Mallock, "A Method of Preventing Vibration in certain classes of Ships." 7½ p.m. 1. Mr. E. L. Attwood, "The Admiralty Course of Study for the Training of Naval Architects." 2. Mr. J. B. Millet, "Submarine Signalling by Means of Sound."

Royal Institution, Albemarle-street, W., 9 p.m. Lord Rayleigh, "The Law of Pressure of Gases below Atmosphere."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. Mr. D. B. Morrison, "The Influence of Oil on the Ultimate Strength of Boiler Furnaces."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Lithography."

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 8 p.m. 1. Mr. R. J. Sowter, "Ellipsoidal Lenses." 2. (*a*) Dr. W. Watson, "The Determination of the Moment of Inertia of the Magnets used in the Measurement of the Horizontal Component of the Earth's Field;" (*b*) Exhibition of a Series of Lecture Experiments illustrating the Properties of the Gaseous Irons produced by Radium and other Sources.

SATURDAY, APRIL 15...Royal Institution, Albemarle-street W., 3 p.m. Lord Rayleigh, "Some Controverted Questions of Optics." (Lecture III.)

CORRECTION.—Page 528, col. 1, line 37, *for* Tavistock *read* Sherborne.

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FRIDAY, APRIL 14, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 12th, 1905; COLONEL GEORGE EARL CHURCH, F.R.G.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Cole, Dr. J. W. E., Mwomboshi River, North-eastern Rhodesia, South Africa.
Hall, William Henry, Statistical Department, Sydney, New South Wales, Australia.
Hawdon, Joseph William, 16, Windsor-road, Denmark-hill, S.E.
Kiralfy, Imre, Tower-house, Cromwell-road, S.W.
Longden, Henry, 447, Oxford-street, W.
Meintjes, Laurens Schmitz, African Farms, Ltd., Maribogo Station, British Bechuanaland, South Africa.
Moore, James, 17, Donegall-place, Belfast, and The Finaghy, Balmoral, Belfast.
Newcomen, A. Gleadowe, Messrs. Cooper, Allen and Co., Cawnpore, India, and Messrs. Allen Bros. and Co., 14, Devonshire-square, E.C.
Parker, Walter Edward, A.M., 217, Haverhill-street, Lawrence, Massachusetts, U.S.A.
Tilley, James Walter, F.C.S., 95A, Southwark-street, S.E.
Weeks, Rufus Wells, "Devonbrink," Tarrytown, New York, U.S.A.

The following candidates were ballotted for and duly elected members of the Society:—

Arnold, W. Hacker, Messrs. H. Whitlock and Co., Holland-gate, Kensington, W.
Gibbons, William Pike, J.P., C.C., Ruiton-house, Upper Gornal, Staffordshire.
Habibullah, Khan Bahadur Md., Vellore, North Arcot District, Madras, India.
Henley, Mrs. A. L., 7, Oxford-square, W.
Jack, Stuart Maclean, 42, Victoria-road, Upper Norwood, S.E.
Jackson, Walter Geoffrey, Prestwick, near Witley, Surrey.
Macdonald, David Baird, F.C.S., 127, Evington-road, Leicester.
Ridley, Frank R., 10, Russell-street, Covent-garden, W.C.
Scholes, William, A.R.C.Sc., F.C.S., 102, Victoria street, Radcliffe, Lancs.
Taylor, Thomas, Rosendale, Newcastle-under-Lyme.
Wilkinson, Henry Ernest, 31, Priory-park-road, Kilburn, N.W.

The CHAIRMAN, in introducing the reader of the paper, said that the subject of the paper was the vast area of Central Brazil known as Matto Grosso, a region more than two and a half times the size of France. Although its rivers had been to a large extent explored, the interior parts of the country were still *terra incognita*. The author had lived in Matto Grosso for several years, and had paid great attention to its mineral wealth, its industrial resources, and its future possibilities.

The paper read was—

THE INDUSTRIAL RESOURCES OF THE STATE OF MATTO GROSSO, BRAZIL.

By G. T. MILNE, F.R.G.S.

The name of Matto Grosso, or "dense forest," was given in the seventeenth century by the Portuguese adventurers, known as "bandeirantes" or "sertanistas," to the country extending from the north of what is now the State of Goyaz, Brazil, to the head waters of the river Guaporé. The discoveries of gold which they had made in Minas Geraes stimulated the ambition of these pioneers to push their explorations further towards the west, and when, after being accustomed to the comparatively open country of the highlands of Saõ Paulo and Minas Geraes, they met with a wide belt of thick forest extending westwards for hundreds of miles, the change in the physical features of their surroundings doubtless suggested the name. How far the whole territory now known as Matto Grosso answers to the description may be inferred from the fact that in the southern part of the

State there are wide tracts of open country adjoining the rivers Saõ Lourenço and Paraguay, while the great central table-land is also more or less open.

In the sixteenth century the Spanish adventurers had sailed up the river Paraguay on their journey to Peru, but there can be little doubt that the general exploration of Matto Grosso was not begun until more than a century later by the Portuguese.

Situation and Area.

The State of Matto Grosso lies between 7° 30′ and 24° 10′ of south latitude, and between 50° 35′ and 65° 10′ west of the Greenwich meridian. It occupies the most central part of South America, and is bounded on the north by the States of Pará and Amazonas, on the west by the Republic of Bolivia, on the south by the Republic of Paraguay, and on the east by the Brazilian States of Goyaz, Minas Geraes, Saõ Paulo, and Paraná. It is nearly four-and-a-half times the size of Great Britain and Ireland, its area of more than 533,000 square miles entitling it to rank as second only to Amazonas, the largest of the twenty States forming the Brazilian Republic.

Physical Features.

The main physical features of this vast territory are the low-lying open grass lands of the south adjoining the river Paraguay and its tributaries, the table-land forming the central part of the State, and the forest belt already mentioned. The south may be said to form part of the vast plain extending northwards from the Pampas of Argentina through the eastern portion of Bolivia. This plain, roughly described, stretches as far west as the Andes, as far north as the great central plateau of Brazil, forming the water parting between the Amazon and the River Plate, and as far east as the elevated land masses forming the southern extension of that table-land. As showing its gradual declivity towards the River Plate, it may be mentioned that, according to the engineers engaged by the Bolivian Government in the delimitation of the frontier with Brazil in 1878, the river Paraguay is only 288 feet above sea level at Corumbá, although at this point distant more than 1,600 miles from Monte Video. During the rainy season, which lasts from November till April, the river Paraguay and its tributaries overflow their banks and flood the adjoining plain for an enormous distance. This part of the country then presents the appearance of an inland sea, and travelling, which in normal conditions can be done on horseback, has then to be done by canoe. When the rain ceases in the region drained by the Upper Paraguay, the pressure exercised by the water in the main channel is withdrawn, and the repressed waters on the plain then escape. Owing to this circumstance, the phenomenon is presented of a river rising during its lower courses when the upper levels are subsiding.

This flood plain is generally open and covered with pasture; it supports thousands of head of cattle, which during the period of flooding are driven off to higher land. The black soil appears to be admirably suited to the cultivation of rice. Isolated masses, forming hills which rise from the plain, are occasionally met with, notably near Corumbá, and further north near the banks of the river Paraguay.

The table-land I have mentioned extends across the State in a W.N.W. direction from Goyaz to the cataracts of the Rio Madeira. Its eastern portion, which is known as the Chapada, a name commonly used in Brazil to denote a table-land, also extends towards the south until it joins the hills of Paraguay, while the western portion is known as the Serra dos Parecis (from the tribe of Indians of that name), and the Cordilheira Geral or General Range. From the latter there is an extension towards the north lying to the west of the Tapajos River, known as the Cordilheira do Norte or Northern Range, but this portion of the State has been very imperfectly explored, and existing maps are more or less conjectural with regard to it.

This plateau rises in some places to a height of nearly 3,000 feet above sea level, and it has been remarked that the wide plain below looks like a sea from its edge, while the escarpment with its inlets and promontories bears a curious resemblance to a coast-line. Commenting on this resemblance, Dr. John W. Evans, who visited Matto Grosso in 1891, says, in a valuable paper on the geology of the State contributed to the quarterly journal of the Geological Society for February, 1894, that it is not necessary to have recourse to marine action for an explanation of the present configuration of the country. As seen from Cuyabá, the outline and form of the precipitous cliffs of reddish sandstone of the table-land, distinctly visible in the clear atmosphere at a distance of 40 miles, form a striking feature in the landscape, while the view from the edge towards the plain is certainly suggestive of the sea as observed from

cliffs. Towards the north the table-land is believed to sink gradually towards the Amazon Valley, but the land separating the rivers flowing north, is, as I have before indicated, only imperfectly known. The table-land may be regarded as forming the water parting between the river Amazon and the River Plate.

Towards the end of the eighteenth century, Luiz Pinto, Captain-General of Matto Grosso, attempted the canalisation of a short tract of country separating the Alegre and the Aguapehy—tributaries respectively of the rivers Guaporé and Paraguay—with the idea of opening direct communication between the Plate and the Amazon, but the project was abandoned. In the quaint language of his despatch to his royal master in Lisbon, "the equinoctial sea is united with that of the 36° parallel of southern latitude by a canal of 3,500 leagues formed by nature." His project was grand in conception, but I fear that it would prove practically impossible of execution except for navigation of the smallest craft.

The country of the plain more immediately adjoining the plateau is somewhat undulating in character. The formation is generally clay slate, with but a thin layer of vegetable soil overlaying it. The vegetation is poor, the grasses being harsh and unsuitable for pasturage, while the trees are stunted in growth. The slates, which are traversed by numerous quartz reefs, are sometimes overlaid with a cemented deposit composed of quartz pebbles and iron oxides, locally known as *canga*. It is in these formations that the early pioneers of Portugal found auriferous deposits of such extent and value as led them to found the present capital, Cuyabá, and other mining centres in the State.

On ascending the table-land somewhat different conditions obtain. Here the slates are overlaid by sandstones, and the soil is generally of a dark red colour. The undulating surface is in parts covered with thick coarse grass, which if better in quality than that of the slates is inferior to the rich pasture of the flood plain, while there are tracts (such as parts of the Serra dos Parecis) which are sandy and barren in character. The table-land is generally lightly timbered except along the water courses. Excellent coffee is raised at the village of Sant Anna da Chapada on the table-land near the Capital, and the land generally may be regarded as being more adapted to agricultural than to pastoral pursuits.

The forest from which the State takes its name is thoroughly tropical in character, and presents similar features to the great Amazon forest further north, of which indeed it may be regarded as the southern expression. There one finds the Hevea, yielding Pará rubber, vanilla, balsam of copaiba, jaborandi, Brazil nuts, several kinds of palms, and an infinite variety of trees and plants yielding valuable timber, fibres, dyes, and medicines. The climate and soil are alike totally different from those of the table-land and river plains, and the natural products are correspondingly modified. The whole State is a perfect elysium for the botanist, so rich and varied is the flora. Among other workers in this field, Mr. Spencer Moore, of the Natural History Museum, South Kensington, has rendered valuable service to botanical science by a contribution to the Transactions of the Linnean Society, December, 1895, embodying the results of his work in connection with an expedition to the country in 1891-92.

To those in search of sport, the country offers more attractions than many other parts of South America—jaguar, puma, tapir, antbear, camp and forest deer, and wild pig are all to be met with, as well as numbers of smaller animals, while winged game is varied and abundant.

CLIMATE.

The main factors determining the climatic differences of the State, are the division of the wet and dry seasons, and the differences in altitude. The rains in and about the valley of the Upper Paraguay begin about October or November, and continue until about April or May. The amount of rainfall is considerable, especially in the forest belt; but in Cuyabá, the capital, it is less. As the result of three years observations in Cuyabá, Dr. Morsback states in the "Revista do Observatorio," published at Rio in 1890, that the annual average amounted to 1,166 mm.; this is between 45 and 46 inches. Thunderstorms usually accompany the rains. During this period the heat is considerably less than in the dry season. The maximum of heat is probably attained in the month of September—*i.e.*, immediately preceding the rainy season. The mean annual temperature at Corumbá is, according to the Belgian Consul there, 29° Cent., but that of the capital is lower. According to observations published in Dr. João Severiano da Fonsecá's work, "Viagem ao redor do Brazil," the mean annual temperature at Cuyabá for 1876 was 25·71° Cent., and for 1877, 26·72°.

The forest region is hot and damp, and the

river plains are also hot, but not so enervating. When we ascend the table-land a delightful change is at once apparent. Here the climate is bracing as compared with the other districts, even at midday a fresh breeze mitigates the heat of the sun, while the nights are decidedly cool.

As regards health, malarial fever is more or less prevalent in the forest belt and in the river valley, while goitre is noticeable among the inhabitants on the plateau. The fact that yellow fever is unknown confirms what has often been stated, viz., that it is never found far removed from the sea-coast. Speaking generally, the table-land may be considered decidedly healthy and admirably suited as a place of residence for Europeans, while I always found the capital, which is 720 feet above sea-level, to be quite healthy.

Population.

The population of this vast territory probably does not exceed 90,000, not including the wild Indian tribes of the interior, as to which exact data are not available. It is composed mainly of Brazilians descended from the early Portuguese settlers, whose living representatives, however, show marked evidence of contact alike with the negroes introduced as slaves from Africa and with the aboriginal Indians. Most of the foreigners settled in the State, such as Portuguese, Italian, or German, are engaged in trading. The labouring classes are nearly all native Brazilians, a few Bolivians and Paraguayans being also met with. The educated native here, as in many other parts of Brazil, while sometimes engaged in agricultural or pastoral pursuits, or in commerce, often limits his ambition to securing a post under Government when his party is in power.

Many years ago the late Baron of Melgaço, an authority on all matters relating to Matto Grosso, calculated that the wild Indians numbered 25,000, forming eighteen separate tribes. If this estimate were at any time reliable, one may safely assume that the total number is now less, as intertribal wars tend to reduce the number, and the untamed Indian tends to disappear before the encroachment of civilisation on his domain. Some of the tribes are stated to be anthropophagous, and several are well-known to be hostile to the white man; as an instance of this, I may mention that some few years ago a personal friend of my own was killed by an Indian arrow when travelling in the forest near the old City of Matto Grosso. Some of the more peacefully-inclined tribes engage in agriculture, forming large clearings in the forest, while others live on the fish that abound in the rivers, or live by the chase. They are mostly of Tupy stock, and at no time appear to have arrived at a degree of civilisation at all comparable with that of the races ruled by the Incas in Peru or Bolivia.

Rock picture writings are found at Gahyba, on the river Paraguay. These appear to be crude representations of the heavenly bodies, serpents, a human hand and foot, and palm leaves, and they are similar in character to the rock pictures met with in other parts of Brazil. Whether they are the work of a race long since extinct, or of the ancestors of the present Indian tribes, is a question difficult to determine. It may be noted that it is somewhat doubtful whether the aborigines understood the value of gold when the early pioneers of Portugal invaded their country.

Means of Communication.

A glance at the map will show that the State is extremely well watered, but, unfortunately, many of even the largest rivers are at some part of their course so impeded by rapids as to prevent, or seriously interfere, with navigation. Especially is this the case with the rivers flowing north towards the Amazon. In compensation these very obstacles may, in some cases, be one day utilised to generate electrical power for railways linking up river stretches open to navigation. At present the sole means of water communication with the exterior is by the river Paraguay and its tributaries. Leaving Monte Video, one can sail northwards by steamer for a distance of over 2,000 miles to Cuyabá, successively navigating the waters of the Paraná, Paraguay, Saõ Lourenço, and Cuyabá, while the Paraguay itself can, during the rainy season, be navigated by vessels of light draught to within a few miles of the ancient mining centre of Diamantino.

The Brazilian Government maintains a bi-monthly service of mail steamers by the former route, the voyage from Monte Video to Corumbá occupying about ten days. From Corumbá to Cuyabá the voyage occupies about five days and is performed by light draught steamers. A few small steamers are also engaged in carrying freight. Freights from Monte Video to Corumbá average about £2 3s. 6d. per ton, while those from Corumbá to Cuyabá run to over £5 per ton. Beyond Cuyabá navigation is obstructed by rapids, but

it seems probable that by the expenditure of a little energy and capital it might be opened as far as Rosario, a small town some eighty miles further north.

RAILWAYS.

So far nothing has been accomplished in the way of railway construction within the borders of the State, although, even in the time of the Empire, various projects were laid before the authorities and concessions granted. The need for a line connecting Cuyabá with the Federal capital at Rio is apparent on strategic grounds, because, in the event of complications arising with the Argentine Republic, Brazil might find her access to Matto Grosso through the Paraná-Paraguay river system closed, as happened during the Paraguayan War, when all goods had to be brought to the capital by mule-trains from Rio. The need is further emphasised in the event of revolutions breaking out in Matto Grosso, as has occurred more than once since the fall of the Empire in 1889.

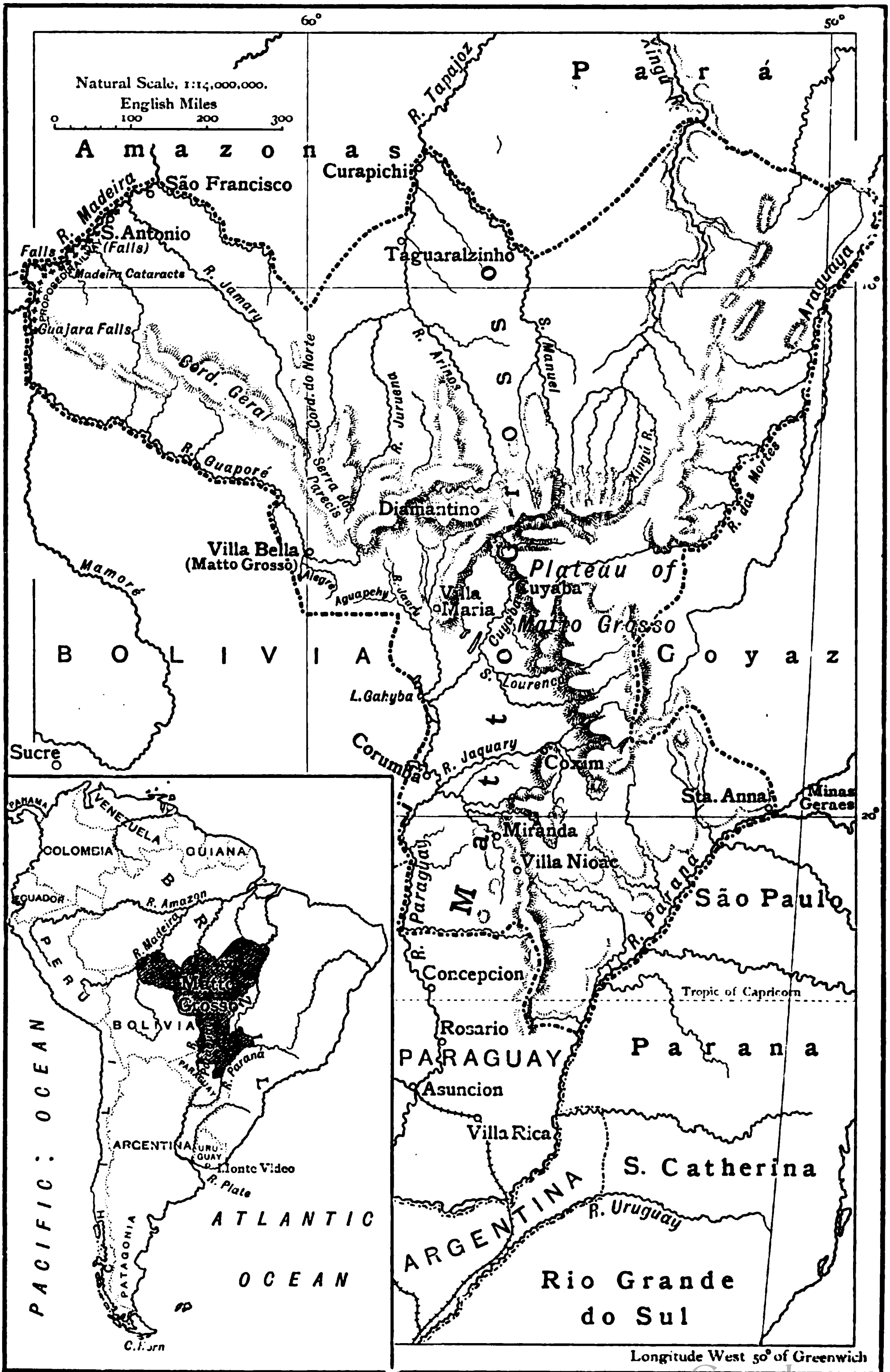
The Mogyana Company's trunk line through Saõ Paulo and Minas Geraes has reached Catalao in Goyaz, and it is intended that it should ultimately be prolonged to Cuyabá, but in the event of this extension being unduly delayed in execution it seems probable that the Federal Government may itself construct the line.

A combined railway and navigation scheme, which when executed will have an important bearing on the future of Matto Grosso, as well as Goyaz, is that dealing with the Araguaya and Tocantins rivers. A concession has been granted to a Belgian syndicate for the construction and exploitation of a railway from Alcobaça to Praia da Rainha to compass a stretch of the river Tocantins, encumbered with rapids to such an extent as to render navigation impossible. Navigation is already open by steamer between Pará and Alcobaça. The terms of the concession include both federal and State subventions for navigation, and like guarantees of interest on cost of construction of railway, while in addition the syndicate will receive free grants of land adjoining the route amounting to about 100,000 square kilometres, and preference in equal conditions in the working of all mines located in a zone of 40 kilometres on each side of the route. The district traversed by the route is said to be rich in rubber, and in the State and city of Pará Goyaz, and Matto Grosso would find a ready market for the surplus cattle from their plains, while there is room for millions of settlers on the healthy table-land of the two last-mentioned States. The scheme would afford the most direct route of all between Matto Grosso and Europe or the United States, bringing Cuyabá within 200 kils. of a point of free navigation on the Rio de Mortes, a tributary of the Araguaya.

Another scheme of importance to Matto Grosso is that which contemplates the construction of a railway round the falls of the Madeira. It is one of the oldest railway projects connected with the State, the first concession having been granted more than thirty years ago. More than one attempt has been made to carry it out, but hitherto without success. It now appears, however, that in the recent re-adjustment of frontier with Bolivia, Brazil has undertaken that this road, so necessary to Bolivia as an outlet towards the Atlantic for the produce of her eastern provinces, shall be constructed within four years. When it is, the Guaporé and Mamoré rivers will be more extensively navigated than is possible at present, and the whole of the western portion of the State, which is believed to be rich in rubber as well as minerals, should then be opened up.

At present nearly all the internal transport, where not effected by water, is done by pack mules or oxen. These mule, or bullock trains, laden with rubber or agricultural produce, are frequently met with when travelling in the interior, as, although of late years the State Government has done something towards improving the roads, these are, as a rule, unsuited to wheeled traffic; and it is only in one or two districts, that the heavy covered-in carts, with solid spokeless wheels, drawn by four or five yoke of oxen, are met with. One can always tell when a bullock cart is approaching long before it is visible, by the continuous singing sound caused by the wheels revolving on ungreased axles, it being an article of faith among the drivers of such vehicles that were the creaking sound to cease the bullocks would cease to pull!

Transport by ox-cart or pack-mule or bullock is tedious—only from 20 to 30 miles being covered in a day. At sundown a camp is formed near a stream, the animals are turned loose to graze, and the men sling their home-spun cotton hammocks, which form an indispensable part of their equipment, among the trees. Frequently several hours are spent the next day in rounding up the animals, when the journey is resumed. Sometimes the night is passed at a farmhouse, where old-fashioned, but none the less genuine, hospitality is ex-


Natural Scale, 1:14,000,000.
English Miles
0 100 200 300
60°
50°
Amazonas
Pará
São Francisco
Curapichi
R. Tapajoz
Xingu R.
R. Madeira
S. Antonio (Falls)
Falls
Madeira Cataracts
R. Jamary
Taguaralzinho
Guajara Falls
Cord. Geral
Cord. do Norte
R. Juruena
R. Arinos
S. Manuel
Xingu R.
R. Araguaya
R. das Mortes
R. Guaporé
Serra dos Parecis
Diamantino
Villa Bella (Matto Grosso)
Mamoré
Alegre
Aguapehy
R. Jaurú
Villa Maria
Plateau of Cuyaba
Matto Grosso
Cuyaba
S. Lourenço
BOLIVIA
Goyaz
L. Gahyba
Corumba
R. Jaquary
Coxim
Sucre
Sta. Anna
Minas Geraes
20°
Miranda
Villa Nioac
R. Paraguay
R. Parana
São Paulo
Concepcion
Tropic of Capricorn
Rosario
PARAGUAY
Parana
Asuncion
Villa Rica
S. Catherina
ARGENTINA
R. Uruguay
Rio Grande do Sul
Longitude West 50° of Greenwich
PANAMA
VENEZUELA
COLOMBIA
GUIANA
ECUADOR
R. Amazon
BRAZIL
PERU
R. Madeira
Matto Grosso
BOLIVIA
R. Parana
PARAGUAY
CHILI
ARGENTINA
URUGUAY
Monte Video
R. Plate
PACIFIC OCEAN
ATLANTIC OCEAN
PATAGONIA
C. Horn
Emery Walker sc.

tended to the traveller and his dependents. When one is fortunate enough to travel on horse or mule back, unencumbered by pack animals, it is possible to cover 50 or 60 miles in a day.

Telegraphic Communication.

Telegraphic communication has existed for some years between the capital and Rio by means of an overland line, and quite recently a service has been established between Cuyabá and Corumbá.

Agriculture and Extractive Industries.

Agriculture is generally in a very backward state, so much so is this the case that although the total population does not exceed 90,000, excluding the wild Indian tribes of the interior, staples such as flour, rice, maize, and beans are imported from the exterior. This is partly due to lack of labour. When slavery was finally abolished in Brazil in 1888, many fine estates went out of cultivation in Matto Grosso, and could, a few years ago, and probably can still, be purchased for the proverbial song. By the abolition of slavery the economic position in Brazil was profoundly modified, and the more inland parts of the country have not yet recovered from the effects of so radical a change. The year following the abolition, saw the downfall of the Monarchy, and this was followed by a period of political unrest, culminating in some instances in disturbances of a kind only too common in South American countries. A situation was created far from favourable to the attraction of either capital or immigrants. Especially was this the case in Matto Grosso, which the tide of foreign immigration reaches but slowly, while Argentina, already well-known to emigrants from Southern Europe, stands at the gateway ready to offer a home on her wide plains to all who come.

Our consular agent at Corumbá, Mr. C. C. Cooper, in his report for 1903, informs us that the State Government was making arrangements for the introduction of 600 families of Slavonian origin, 300 of which were for settlement on the plateau near the capital, and the remainder in the south of the State.

There are on the river Cuyabá several sugar factories properly equipped with modern machinery, which I am informed have yielded fortunes to their owners. The sugar and white rum which they produce is all consumed locally, and is insufficient in quantity to meet the demand. The soil adjoining the river seems specially adapted for growing sugar-cane, which is stated to yield a crop for fifteen or twenty years in succession without being replanted.

Of far greater importance than agriculture are what may be called the extractive industries carried on in the State; these are the collection of Paraguayan tea, rubber, and ipecacuanha. The forests where the Paraguayan tea or *máte* is collected lie in the south near the Paraguayan frontier. Belonging to the State, they are leased to a firm in Rio de Janeiro which employs a large body of labour, mainly Paraguayan, to collect and prepare for market the leaves of the shrub known as *Ilex Paraguayensis*.

In 1903 the value of the máte exported from the State was £118,000—considerably more than half of all the other exports taken together. Most of this máte is consumed in Argentina and Uruguay, where it still forms the favourite beverage of at least all the lower class of natives.

Rubber is collected in the valleys of the Xingú, Tapajoz, Guaporé, Mamoré, and Madeira, and their numerous tributaries, where there are extensive forests containing trees of the Hevea species. Of recent years the great demand for and high price of rubber, especially the favoured Pará, has led to increased attention being paid to this branch of industry in the State. A large proportion of the rubber is exported through Cuyabá and Sao Luiz de Caçeres on the river Paraguay, where it reaches the river Plate *en route* for Europe, although some is also exported *viá* the Rio Madeira down the Amazon.

The industry is organised on practically the same lines as those obtaining on the Amazon, viz., advances in cash and goods are made by merchants to the owners or lessees of the forest, who in turn make advances to the workmen. The forests are held under title from Government. Large profits are made by those engaged in the industry, but serious losses have also to be faced on account of sickness or death among the cutters, and also through the dishonesty of the latter, who when opportunity offers do not scruple to sell their produce for cash to merchants other than those making the initial advance. So far, I believe, no attempt has been made to cultivate the rubber tree in this its natural habitat. Judging from results obtained in Ceylon and other parts of the East, such an enterprise should prove lucrative, although this is a form of investment

demanding considerable patience on the part of the capitalist, seeing that no return can be expected from the trees for some eight or ten years. Assuming, however, that no natural or artificial substitute for rubber is found, it seems as if the present high prices will be maintained and even exceeded, and a plantation laid out in a tract of forest having a sufficient number of naturally grown trees in working to pay expenses, joined to the cultivation of cocoa, cotton, or other tropical produce, as well as food supplies for the labour, offers, in my opinion, a reasonable prospect of success from a financial point of view. The value of the rubber exported from the State for the years 1901-1903 was, according to our Consular Agent's Report, as follows: — 1901, £32,783; 1902, £37,748; 1903, £41,404 15s. There is an *ad valorem* duty of 23 per cent. payable to the State Government on export. I understand that recently new sections of forest have been opened up, so that for some time to come the output is likely to increase.

Another product of the State is ipecacuanha, or "poaya," as the natives term the well-known drug. Its habitat is in the dense forest bordering the right bank of the river Paraguay and its tributaries, between the 15th and 16th parallels of latitude. The ipecacuanha plant is small, growing only a few inches above the ground; its curious vermiform root contains the active principle—emetine, used in medicine. It is dug up with an iron-shod pointed stick called a *saracua*, dried by exposure in the sun, and baled for market. The industry is financed by the same methods as those I have referred to as being in vogue in connection with rubber. The cultivation of the plant in Johore has, I learn, been attended with success, and the risk which at one time appeared to be probable of a diminished output through the exhaustion of the Matto Grosso forests, has now been obviated, as considerable quantities are now exported from Johore plantations. The value of the root exported from Matto Grosso in 1903 was £5,001 16s., or a little over a third of what had been exported two years previously. There appears no reason why a plantation of ipecacuanha in Matto Grosso should not with proper supervision be a success.

Cattle Raising.

In some parts of the State large herds of cattle are raised, but the distance from market is an obstacle to fuller development of the pastoral industry. Near Sao Luize Caçeres on the Upper Paraguay there is an important Saladeiro, or meat-preserving establishment, owned by a Belgian company, and extract of meat figures among the exports of the State for 1903 to the extent of close on £13,500, showing an increase during two years of over 74 per cent., while for the year under review dried hides to the value of over £40,000 were exported.

Much might be done to improve the breed of cattle by the importation of fresh stock and the subdivision of the vast estates, but at present the same system, or rather lack of it, exists in the majority of cases as existed in the Argentine Republic in the early days.

Mineral Wealth.

No description of the resources of the State would be complete without a reference to its mineral wealth. This is considerable, and, as I have indicated, it was due to the discoveries of gold early in the eighteenth century that Cuyabá was founded in 1719 on the left bank of the river of the same name.

The municipal records, still extant, show that the amount of gold on which a tribute of one-fifth was exacted by the Colonial Government on behalf of the Portuguese Crown was very large, and, as contraband was commonly resorted to where possible, these official data must be taken as under-statements. From an excavation near the capital, tradition has it that over 150,000 ounces of alluvial gold were extracted in a month. Whether this statement can be accepted or not, the old workings are so extensive as to be in themselves evidence of the past importance of the industry, as they can hardly be regarded as representing unremunerative labour. To-day, during the rainy season children may be seen searching for gold in the streets of the capital after a heavy rainfall has effected disintegration of the soil.

Other ancient mining centres are Livramento and Poconé to the west and south-west, and Diamantino to the north, in addition to numerous villages in the north and north-west now completely abandoned. The work was not always confined to the gravel deposits, as in some cases shafts have been sunk on small but rich quartz leaders, from which the gold-bearing rock was extracted, crushed, and panned off in bateias—the name given to the wooden pans still in use in washing gold in Brazil.

Important diamantiferous deposits were also worked at Diamantino some 120 miles north of

the Capital; this town must not be confounded with the better known town of Diamantina in Minas Geraes, where the diamond is also found. The Brazilian diamond is met with under conditions somewhat different from those obtaining in the world-famous Kimberley mines. So far as I am aware the "blue ground" and "volcanic pipe" formation has not been met with in Brazil. Many of the stones occur in river beds associated with auriferous gravels; in this case they are clearly derived from some matrix, the nature of which appears to be somewhat obscure. According to the geologists Derby and Gorceiz, who have made a special study of the question, the Brazilian diamond is also met with in a schistose granular quartzite of a flexible kind known as Itacolumite, a mineral which takes its name from a range of mountains near Ouro Preto in Minas Geraes, but this also may be a secondary formation.

The French traveller, Castelnau, who explored Matto Grosso in 1843-44, states that sandstones occur in the vicinity of the workings near Diamantino, and from these he supposed the diamonds to be derived. Some years ago a rich find was made near Diamantino, stones to the value of £20,000 having been taken out in a short time.

Present Position of Mining.

Mining operations both for gold and diamonds have declined in importance since an epidemic of small-pox swept the State in 1867, and since the abolition of slavery. Until recently they were limited to the work carried on by individual native prospectors. As the result of these, small parcels of gold-dust and diamonds are still occasionally acquired by local merchants. In 1902, however, a company known as the "Transpacific Gold-mining Company," was formed at Charters Towers, Queensland, with the object of dredging the river Coxipo d'Ouro for gold, under a concession granted by the State Government.

This stream, which rises on the plateau to the north-east of the capital, falls into the river Cuyabá on its left bank about a league below the capital. A dredge was constructed by a well-known New Zealand firm, and although it capsized during a flood, it is now, I understand, again at work and yielding satisfactory returns, a recent return showing thirty ounces of gold for a run of fifty-three hours. During the operations small diamonds have also been recovered.

Consular-Agent Cooper reports that other rivers in Matto Grosso have lately been prospected, and that new syndicates have been formed on the strength of the favourable reports received. Mr. Cooper also states that he has no doubt a great many of the rivers are rich enough to be profitably dredged, and that capitalists are commencing to recognise the fact. I have learnt only recently that reefs near the capital are also now being examined on behalf of English capitalists, so that it is not improbable that at no distant date the gold and diamond mining industry, which did so much for the State in the past, may be revived.

Manganese and Other Minerals.

An extensive deposit of manganese exists in the mountains of Urucum and Morro Grande, a few miles south of Corumbá, at a height of over a thousand feet above the level of the river Paraguay. Mr. Consul Cooper refers to it in the report which I have already quoted. The mode of occurrence of the deposit is such as to render extraction comparatively easy, while the height above water level would ensure immunity from water as a disturbing factor in working, and at the same time make the construction of an aerial cable-way to the river Paraguay easy. If a railway were found more convenient, I believe that sufficient electrical power could be generated to operate it from a stream which rises in the mountains where the deposit exists. From the railway terminus it would be necessary to ship the mineral in barges to Rosario on the river Paraná (a distance of over 1,400 miles) where it could be transhipped to ocean-going steamers. This question of trans-shipment has probably hitherto proved the main obstacle to the working of the deposits, but the whole question appears to be one worthy of attention on the part of those interested. In other parts of Brazil manganese deposits are being successfully exploited on a large scale, and much of the ore is of excellent quality.

Copper is stated to exist on the River Jauru, between Saõ Luiz de Caçeres and the old city of Matto Grosso. Platinum is also reported to have been discovered near Diamantino, probably in auriferous gravels, while deposits of high-grade iron ore, close to those of manganese, near Corumbá, are practically inexhaustible.

Mining Laws.

The mining laws of the State are liberal, both as regards the area granted for explor-

ation, and also as regards the conditions of working.

By the Constitution of the Republic, the minerals are declared to belong to the owner of the soil, or in the case of public land, to the State. At present each State has its own mining code. In Matto Grosso, concessions to work mineral deposits are preceded by an exploration right; under this, one may obtain the right of prospecting any area up to 280 square miles in extent, on depositing a sum of about £250 with the Government. This sum becomes forfeited if operations are not begun within two years. On completion of the preliminary operations the concession to work is made—usually for thirty years. Under this one hundred and fifty claims of about 170 acres each may be pegged out. The royalties charged are insignificant, but there appears to be no guarantee that a heavy export duty on the product may not be exacted.

Commerce.

The commerce of the State is slowly but surely developing. Mr. Cooper, however, considers that if the United Kingdom does not participate more fully it is solely due to the action of manufacturers here, who content themselves with forwarding catalogues printed in English, whilst our Continental competitors have theirs translated into Portuguese and Spanish, appoint active agents at Corumbá and Cuyabá, and periodically send out competent representatives to visit old clients and form new connections.

Further, German, French, and North-American traders give longer credit to desirable firms than ours do, and whilst a large majority of local merchants would doubtless prefer to deal with British firms, they are unable to do so owing to the hard-and-fast conditions offered, and to the want of sufficient information regarding our manufactures.

Mr. Cooper's complaint as to catalogues being printed in English is one with which the public has become familiarised through reading consular reports from almost every part of the world, and adds another proof, were one needed, of the lack of initiative which still appears to characterise a large section of our commercial community.

The total exports from the State during the year 1903, calculated at the exchange of 1s. per milreis, amounted to £219,322 13s. Deducting the value of máte, or Paraguayan tea, exported to neighbouring republics, £118,000, there is a balance of £101,322 13s.. made up principally of rubber, hides, and extract of meat.

From the official returns it is impossible to determine what proportion of this latter sum represents the exports to the United Kingdom, as the exports to Europe (nearly £73,000) are entered as being shipped to Monte Video in transit. Germany and France take a certain proportion, but the greater part goes to the United Kingdom.

The imports for the same period amounted to £247,313. Of this sum about 55 per cent. represents imports from other Brazilian States, and while nearly £14,000 are entered as the value of imports from the United Kingdom, this latter figure does not represent the total, owing to the goods shipped out of bond from Monte Video, and those "in transit" from Europe introduced into the State without proper classification, being entered as imports from Uruguay. Our exports to the State comprise:—Hardware, machinery, tools, drugs, woollen and cotton goods, paints, oils, cutlery, wire for fences, ironmongery, gunpowder, sewing machines, printed goods, &c.

Banking facilities do not now exist at either Corumbá or Cuyabá since the Banço Rio and Matto Grosso went into liquidation. This state of affairs tends seriously to hamper commercial transactions, the importance of which justifies the establishment of an agency of one of the Rio banks in the opinion of our Consular representative.

Political Constitution.

As a constituent part of the Federal Government of Brazil, Matto Grosso now manages its own internal affairs, electing its own Governor or President, and having its own local legislature and judicature, besides sending representatives to the Federal Congress. In the time of the Empire the Governor was nominated by the Central Government, which appears to have done little towards advancing the interests of a province considered too remote to be of much importance. As showing the ignorance at one time prevalent in Rio regarding the conditions of life in Cuyabá, a resident of the latter was gravely asked by a citizen of Rio if it were true that jaguars roamed the streets of the former city.

Principal Towns.

Cuyabá, with a population of about 15,000, is the largest city in the State. Here is the residence of the Governor, the Legislature, and the various Government offices, including a war arsenal and military barracks. The

city covers a large area, as nearly all the houses have extensive compounds or yards attached to them. Most of the houses are of adobé, with tiled roofs. The streets are paved with blocks of quartz, undoubtedly extracted by the pioneer miners who founded the city. There is a service of tramcars from the port on the river to the city proper, and Cuyabá can boast of what many a town nearer the littoral cannot, viz., a proper water supply, derived from the river by pumping to a reservoir on an elevated site.

Next in importance is Corumbá, situated on the river Paraguay, and distant from the Capital about 440 miles to the south. It is the seat of the principal Custom-house of the State, and, in addition, is the point where goods in transit for Bolivia are cleared. Close to Corumbá is the naval arsenal of Ladario, founded after the conclusion of the Paraguayan war.

Saõ Luiz de Caçeres is also of some importance on account of its exports of rubber and ipecacuanha.

Villa Bella, also known as the City of Matto Grosso, is situated on the river Guaporé, and until 1820 was Capital of the province, but it had to be abandoned on account of its unhealthiness. It is now in a state of decay, and the former palace of the Colonial Governors and other public buildings are falling into a state of ruin. A few years ago I was informed that there were only a few inhabitants, and that at night the streets were unsafe on account of the incursions of the Indian tribes from the adjacent forests.

The Future Prospects of the Country.

Endowed with great natural resources, there can be no doubt that in a future, not perhaps remote, Matto Grosso is destined to become a great and wealthy State. To achieve her destiny she stands in need (probably more than any other State of Brazil) of capital and labour. To attract this should be the aim of those charged with the administration, and one can only wish success to the recent efforts of the Government directed towards the formation of agricultural colonies, and hope that the various projects for improving the means of communication and developing the mineral resources of the country may be realised.

It is sometimes said that the twentieth century will be one of marked progress for South America. If this prediction be fulfilled, let us hope that Matto Grosso may share in the general prosperity.

DISCUSSION.

Sir Martin Conway thought the members were extremely indebted to the author for the admirable manner in which he had put together so much information, partly from his own observation and partly from information derived from the best authorities. What always struck him about South America, not only about the particular district under discussion, but about many other parts of the country, was the universal report obtained from everybody who visited that part of the world, and made himself at all intimately acquainted with it, of the great natural wealth of those regions. On the other hand, the general trend of the energies of energetic people was towards quite different regions of the world, which were not so obviously rich, and did not present the same natural advantages for rapid development as the attractive and wealthy continent of South America. He believed the time would sooner or later come when more attention would be devoted to South America. It might very well be that in the future the twentieth century would be remembered as the period in history that efficiently discovered that continent. To him South America was chiefly interesting as essentially the continent of romance. There was no other part of the world where so much romance was left. The moment a traveller landed in South America he found himself in a country where nothing was done as he was accustomed to seeing it done elsewhere. The people preserved a character of their own, which they did not show the smallest tendency to file down and mould into the recognised form of the Western world; on the contrary, they had a faculty, which he was delighted to observe, of turning the newcomer very rapidly into one of themselves. He, therefore, had good hopes that South America would never become, even in the future, the kind of smug, Philistine, law and order, cold bath, honest behaviour continent which people were accustomed to regard as the ideal of the future. On the contrary, he hoped South America would long continue a region of moderate law and order, a place where things might happen unexpectedly, where what happened one day would not necessarily happen the next, which was not entirely thatched with newspapers, and a place where advertising did not pay. Generally speaking, South America was a most delightful, friendly, happy and romantic continent, a place where a man could go and really have a holiday. He therefore looked forward to the twentieth century, when it made full acquaintance with South America, bringing back into the Old World a sort of breeze of freshness and a new spirit of adventure and of life which had passed out of it.

Dr. J. W. Evans congratulated the Society upon having a paper on the subject of Matto Grosso by one who was perhaps more qualified than any of his countrymen to speak on the subject, because he had lived longer in the place, and had more oppor-

tunities of studying the characteristics and capacities of the country. When he (the speaker) visited Matto Grosso ten or twelve years ago he had the good fortnne to meet with the author, and would always remember with pleasure their adventures together in the forests and in the wonderful plains of that mighty region. The climate in the upper regions was of a very invigorating character, it being quite as cold at night as in this country. Every farmhouse in that part of the world had a special room set apart for travellers. In the centre of each side of the room was a hook, to which the hammocks of the travellers were slung, so that five people could be accommodated in each room. It was on the high plateau to which the author had referred that he first made the acquaintance of the carts used in the country, being startled about 4 o'clock in the morning by what he thought was the squeaking of a drove of pigs. He hoped in the near future the country would be opened out; with so vast and beautiful a country there was no fear that Matto Grosso would ever cease to be a country of adventure and magnificence to the wayfarer.

Senhor CHERMONT (Secretary of the Brazilian Embassy to the United States) congratulated the author, on the part of his countrymen, on the excellent paper he had read, and expressed the hope that the Chairman, who probably knew more about the country than anybody else, would give an interesting contribution to the discussion.

The CHAIRMAN said the author had referred to the resources of that wonderful land in the interior of Brazil, which might be called the heart of the country, and had in no way drawn on his imagination. Anyone who had visited Matto Grosso must discover in it a wealth of agricultural possibilities, and perhaps one of the great Eldorados of the world. Ever since he was a boy he had heard of the riches of Cuyabá and its vicinity. The ground was highly mineralised in all directions, and he believed it had only been scratched by the old Portuguese miners, despite the number of years they had worked there. The reason why Matto Grosso lay fallow to-day was because of its inaccessibility. Once the problem of easy communication was solved, he ventured to assert that it would become one of the richest, most prosperous, and most productive parts of the Republic of Brazil. Southern Matto Grosso was first crossed by Alexio Garcia, a Portuguese adventurer, who was landed by one of the Spanish expeditions upon the coast of Santa Catherina. He lived for many years among the Indians, and then, working his way inland, organised an expedition to the north of Paraguay, which passed through the Tupi-Guarani tribe and its offshoots; and proceeded to cross the Grand Chaco of Southern Bolivia, and raid the empire of the Incas. That was prior to the time of the celebrated contract in the Bay of Panama between Pizarro, Almagro and Luque for the discovery and conquest of the Inca Empire; he preceded Pizarro's forces by at least four years, and he wished more credit could be given to the brave and daring adventurer. On his return, he fought his way back to the upper waters of the Paraguay, and was there killed by the Indians. He was loaded at the time with gold and silver, which he captured upon the slopes of the mountains before he reached the plateau. A little later than that Senhor Correa crossed the northern part of Matto Grosso, after which a long period of time elapsed until about 1719 or 1720 a Portuguese named Sutil discovered gold in the vicinity of Cuyabá. In 1723, such had been the development in the gold diggings, and such the prodigious quantities of King's Fifths paid at Sao Paulo, that a gold fever took possession of nearly all the people of Sao Paulo, and there was a rush for the diggings. The route they took was that taken by the slave hunters, the Mamalucos, who were half-breed Indians and Portuguese. They crossed the coast range at about 3,000 feet elevation, descended the Tieté river, reached the Paraná which they descended about 100 miles; then went up the river Pardo, and crossed over into the Jaquary river, which entered the Paraguay river, and up the Paraguay to Cuyabá. Many of those expeditions were almost annihilated by the savages in taking revenge for the bad treatment they had received at the hands of the Mamalucos. Later on, when the fame of the gold discoveries became known, many efforts were made to reach Cuyabá and southern Matto Grosso. The first route taken was by way of the Guaporé river, which separates Bolivia from Brazil, an expedition going down that river in 1742 into the Madeira, and then to Para. In 1746, Captain Souza crossed from Cuyabá over to the head waters of the Tapajoz river, descended it, and reached Pará, returning in 1747 by way of the river Madeira and Guaporé, taking a load of goods with him. The reaching of Matto Grosso by the Amazon side was practically out of the question for commercial purposes, the cost of transportation being so great. For instance, in the Xinjú River, lying east of the Tapajoz, there were no less than 400 miles of rapids and cataracts. While the Tapajoz was not so completely interrupted by rapids and falls, it was full of them, and at such intervals that it was a great hardship to undertake its navigation. Considering that the Tapajoz was 1,200 miles long, it would be considered a very large river in the Old World. There was now a prospect of a railway being built round the great bend of the Madeira to avoid its falls and rapids, there being no less than nineteen in a distance of 263 miles, among which he was wrecked in 1872. By a treaty made in 1903 between Brazil and Bolivia over the Acre question, Brazil undertook to build a railway about 200 miles long to avoid these falls; and as it at present costs £80 per ton to carry goods past them, it would be easily understood that the price would be materially reduced when the railway

was built. At the upper terminus of the railway, and concentrating upon it like the wings of a fan, were no less than 3,000 miles of magnificent navigable streams, many of which could be navigated all the year round by craft which drew six feet of water. Whether Brazil could reach Matto Grosso and Cuyubá by that route without spending considerable sums of money in clearing out the obstructions which existed in the Guaporé was, to his mind, a question, but it was possible that might be a very excellent route for the development of western Matto Grosso. Turning to the plateau side, Cuyubá could be reached with 18 inches of water at some seasons of the year, and at others with a little greater draught, but the change of freights at different points on the river made it rather an expensive method of communication for goods. Personally, he believed Matto Grosso would be reached in quite a different direction. He discussed the subject with Dom Pedro II. in 1889, a few months before the fall of the Empire; in fact, Dom Pedro entrusted him with the carrying out of the enterprise. It was not done, as the Empire fell a few months afterwards. South-west of Rio Janeiro there was a bend, and almost at the farthest western point it there was the beautiful bay of San Francisco; and, if from there the old route of the Mamaluco raiders were taken, it would be about the shortest cut to the headwaters of the Paraguay and Cuyabá rivers, and would open the country as Brazil deserved to be opened. He thought it might be said of Brazil that until it changed its policy of developing nothing but its Atlantic fringe it would never be the great country it ought to be. At the present time countries which desired interior development extended their railways far inland, which was the case in Canada, the United States, the Argentine Republic, India, and China; and once Brazil threw one or two main lines of railway into the country from the Atlantic coast, its development would be something enormous. That referred more especially to the line he had indicated, because it would tap the marvellously rich resources of Bolivia, than which he did not believe any other region possessed equal ones; it would tap Paraguay, and would be a grand trunk line for a commerce with the States which must now necessarily lie dormant until such a line is built. The author had referred to the low elevation of Corumbá—288 feet. When it was remembered that Cuyubá, according to the observations of Clauss, was only 660 feet above the sea and 2,000 miles up the river, it gave one an idea of the very little fall there must be in the great Paraguay and Paraná rivers. It was exactly the same with the Amazon. He believed that the 2,500 miles up the Amazon, up to the frontier of Peru, the elevation was not 200 feet. The whole of the region of Central South America was very low, with the exception of North-east Bolivia, which lay on a shelf about 500 or 600 feet above the lower country. Matto Grosso was nothing but the western extension of a vast sandstone plain resting on shales, which again rested on metamorphic rocks, and the country, contrary to the general idea of geographers, did not slope from the Andes to the Atlantic, but the other way. It bore out the fact, which he thought must now be accepted, that the whole of Brazil was separated from the Andean region by a vast inland water communication of lakes and great gulfs. Brazil was interesting from every direction in which it was analysed. Without wishing to go outside the limits of the paper, he had simply desired to make a few remarks to impress upon the audience how the world might reach the vast resources of Matto Grosso. It only remained for him, in conclusion, to move a cordial vote of thanks to the author for his excellent and comprehensive paper.

The resolution of thanks having been carried unanimously.

Mr. MILNE, in reply, said that whatever value his paper had it had been considerably enhanced by the Chairman's remarks.

STATISTICAL ABSTRACT OF THE BRITISH EMPIRE.

The Board of Trade has just issued the first number of the "Statistical Abstract of the British Empire." It is intended to meet the growing demand for statistical information as to the trade, shipping, and production of the Empire, and especially as to the trade relations both between the Empire and foreign countries, and also among its various constituent parts. It is a most convenient compilation. A good deal of its information has already appeared in more formidable volumes, but here it is found in handier form with not a little that is new. It is hoped that in future numbers the information given, more especially in the section dealing with production, will be still more complete, and that it may be possible to add further sections dealing with other kindred subjects. As a general rule, the comparative tables relate to a period of years ending 1903, but certain Tables that have to be compiled from the trade returns of the various colonies and possessions refer to 1902.

Our smallest possession in one sense is our greatest in another, Gibraltar, the first of fortresses, having an area of only 1⅞ square miles. Bermuda comes next with 19 square miles. The area of the Empire is 9,631,000 square miles, and in 1901 it had a population, all told, of 360,646,000, of which 41,458,721 were in the United Kingdom, and 294,361,056 in India, including the Native States. In the twenty years 1881-1901 the population of the Empire increased by 57,460,000.

The growth or decrease in our trade with the principal countries of the world, taking the figures for the six years 1898-1993, are shown in the following Table,

which gives our imports from and exports to the countries named:—

Country.	Year.	Imports.	Exports.
		£	£
Russia ..	1898	20,995,452	16,781,574
	1903	32,871,707	17,783,160
Denmark	1898	11,758,910	3 960,236
	1903	16,829,970	4,750,068
Germany	1898	39,106,992	55,647,400
	1903	45,917,366	57,521,904
Belgium	1898	26,194,527	20,138,829
	1903	33,038,097	20,697,517
France..	1898	59,770,422	35,627,658
	1903	54,003,496	39,121,295
United States.	1898	164,551,814	65,644,155
	1903	178,715,386	79,369,929
Japan ..	1898	5,073,543	12,842,148
	1903	4,709,254	11,752,284

It will be seen that the only country whose imports and exports from and to us show decrease is Japan, and the only other country which shows a decrease is France, whose imports to us have fallen in the six years nearly six millions, almost all of which has occurred in the last three years, our imports from France for 1900 being £59,271,732.

The increase in the trade of India and the Colonies with foreign countries has been great during the last fifteen years. The Australian imports have increased from £6,602,000 in 1889 to £12,975,000 in 1903; that is they have nearly doubled. The imports of the Dominion of Canada have in the same period increased from £14,535,000 to £36,138,000; those of India from £10,214,000 to £20,771,000; even the West Indian Islands have increased their imports from £2,584,000 to £3,087,000. So with the exports, taking the same fifteen years to 1903. In 1889 the Australian exports to all foreign countries (including bullion and specie) were valued at £4,554,000 in 1903, they had risen to £12,716,000. In the same period the exports from the Dominion of Canada had increased from £9,690,000 to £17,241,000. The West Indian Islands show a slight decline—from £3,714 000 to £3,433,000—whilst the exports from India have increased from £32,377,000 to £60,258,000. The exports from the Cape of Good Hope, which include the value of goods sent from the Transvaal, Orange River Colony, and Basutoland, for shipment at South African ports for foreign countries, and include also "Ships Stores," classed with foreign countries in the original trade returns, increased from £479,000 to £3,078,600. The exports of Natal increased from £95,000 in 1889 to £612,300 in 1903.

If we turn to the trade between the United Kingdom and other parts of the British Empire, it will be found that between 1889 and 1903, our imports of animals, living, for food, were increased from £1,629,923 to £3,483,253; of meat of all sorts from £2,442,279 to £8,026,814; of butter from £175,490 to £2,697,536; of cheese from £1,583,216 to £4,991,186; of wheat, from £5,129,084 to £10,658,472; of fruit, from £464,964 to £1,656,707; of tea, from £6,458,406 to £8,364,007; of tin in blocks, from £2,698,622 to £4,198,234. But our imports of rice have fallen from £1,842,981 to £1,454,284; of raw sugar from £3,283,630 to £622,315, of refined from £6,698 to £437; of wool, raw, from £24,009,645 to £18,297,546. Our exports do not show unvarying increases. Exports of cotton manufactures have fallen from £2,685,827 to £1,537,364; of haberdashery, from £1,708,456 to £1,706,354; of coal, from £1,996,811 to £1,816,286; but woollen tissues show a slight improvement, apparel and slops have increased from £4,025,650 to £5,637,947; and all kinds of iron and steel show increases, especially machinery and mill work, from £4,263,177 to £7,970,400.

Turning to production, and commencing with gold, the United Kingdom produced 3,890 ozs. in 1889 and 5,495 ozs. in 1903. Australia shows a large increase, from 1,542,550 ozs. to 4,563,596 ozs., Western Australia constituting by far the larger portion of the increase—from 15,493 ozs. in 1889 to 2,436,311 in 1903. New Zealand increased her output from 203,211 ozs. to 533,314 ozs.. The figures for the Transvaal are not given earlier than for 1901, but the Dominion of Canada shows a large increase, from 62,658 ozs. in 1889 to 1,032,253 ozs. in 1902. Even British Guiana shows an improvement, from 20,216 ozs. to 104,525 ozs. The figures relating to wheat production are very striking. The production of the United Kingdom has fallen from 75,883,611 bushels in 1889 to 48,818,788 bushels in 1903. On the other hand, India produced 256,704,000 bushels in 1890, and 357,162,139 in 1903. The Australian production was very unequal, being 34,039,289 bushels in 1889 and 74,149,634 in 1903, but in 1895 it fell to 18,270,348 bushels, and in 1902 was only 12,378,068. The quantity of coal produced in the United Kingdom has risen from 176,916,724 tons in 1889 to 230,334,469 tons in 1903. In India the output has increased from 1,946,172 cwts. to 7,438,386 tons; in Australia, from 3,976,035 tons to 7,112,078 tons; in the Dominion of Canada, from 2,373,485 tons to 7,139,852 tons. The iron ore produced in the United Kingdem shows some decrease, from 14,546,000 tons to 13,716,000 tons; but the output of pig iron is a little larger, rising from 8,322,824 tons to 8,935,063 tons. Wine comes almost entirely from Australia and the Cape of Good Hope. The Australian output has risen from 3,567,025 gallons in 1893 to 6,159,169 in 1903; but the Cape output which was 5,646,426 gallons in 1889, was slightly less in 1903—5,332,349 gallons. Tea, coming from British India, Ceylon, and Natal, has increased from 141,133,984 lbs. to 361,927,067 lbs., the increase in Natal being from 43,024 lbs. to 1,761,091 lbs. Coffee shows a considerable decrease, from 49,306,636 lbs. to 38,356,801 lbs., largely owing to Ceylon having turned to tea, the Ceylon production having shrunk from 9,865,184 lbs. in 1889 to

1,104,544 lbs. in 1903. Sugar too shows decrease, from 54,700,000 cwts. in 1898 to 50,000,000 cwts. approximately in 1903.

It is regrettable to find that the production of cotton has made very little headway. The total production within the Empire in 1889 was 1,178,652,000 lbs., of which British India contributed 1,173,060,840. In 1903 it had risen to 1,314,103,000 lbs., of which British India produced no less than 1,312,474,000 lbs. Fiji has ceased to grow it, the production of Malta has fallen from 1 350,608 lbs. to 416,752 lbs., that of Cyprus from 3,070,208 lbs. to 337,120 lbs., that of Lagos from 489,950 lbs. to 289,841 lbs., that of Ceylon from 209,187 lbs. to 151,704 lbs. The West Indian Islands are trying to grow a little, but Grenada, which at one time promised to grow a good deal, has fallen away from 375,984 lbs. to 301,010 lbs.

The second part of the statement deals with shipping. In 1889 the tonnage of sailing and steam vessels on the register in each part of the British Empire was 9,471,553 tons, in 1903 it had risen to 11,831,439 tons. But there has been steady decreases in the tonnage of sailing vessels. In 1889 it stood at 4,412,824 tons, in 1903 it had fallen to 2,802,053 tons. On the other hand steam tonnage has risen from 5,058,729 tons in 1889 to 9,029,386 tons in 1903. Nearly all the Colonies show some increase with the exception of the Dominion of Canada, whose tonnage has fallen from 1,022,737 in 1891 to 681,646 tons in 1903; but the decrease has been entirely in sailing ships, Canadian steam tonnage having increased from 113,836 tons to 205,123 tons. If the shipping entered at principal ports in the British Empire is taken, the figures show that London remains far ahead of any other port. In 1888 the shipping entered at the port of London amounted to 7,470,949 tons, in 1902 it had increased to 10,179,023 tons. The next in importance is Liverpool with 6,843,200 tons in 1902, and then Cardiff with 4,688,088 tons, the Tyne ports, namely Newcastle, North and South Shields, and Blyth, coming very near with 4,485,810 tons. Glasgow attracted no more than 1,618,663 tons. Of Colonial ports Hong Kong ranks first with no less than 8,253,591 tons, then follows Singapore with 5,431,530 tons, Colombo with 4,574,271 tons, Sydney with 3,283,399 tons, and Melbourne with 3,157,524 tons. In shipping cleared in the United Kingdom, London was first in 1888 with 5,470,912, Cardiff coming second with 5,148,068 tons, Liverpool third with 4,941,556 tons, and the Tyne ports fourth with 4,392,727 tons. But in 1902 the relative positions were changed. Cardiff, among home ports, stood first with 7,868,556 tons, London second with 7,385,085 tons, Liverpool remained third with 6,314,514 tons, and the Tyne ports fourth with 6,208,812 tons. As with shipping entered, Hong Kong stood first among Colonial ports with shipping cleared with 8,217,621 tons, or nearly half-a-million tons in excess of Cardiff, and nearly a million tons ahead of London.

AUSTRALIAN TRAMWAY SYSTEMS.*

In no part of the world, in proportion to the number of population, are street tramways more extensively used as a means of passenger transit than in the leading Australian State capitals. Although their introduction is of comparatively recent date, their development has been marvellous, and, as in many European and American cities, they have assisted in making riding cheaper than walking, and are causing the omnibuses and other conveyances of a past generation to become forgotten. In Sydney the tramways were originally worked by steam power, the cars being double-decked, like the railway carriages on several of the Paris suburban lines, but subsequently the cable system was introduced, and later on electricity became utilised as a motive power, and with such success that it is only a question of time when the locomotive and cable will be found dispensed with. The various tram-lines, which, like the railways, are the property of the State, form a complete network of communication between nearly every part of Sydney and its suburbs, thus assisting in counteracting the tendency to overcrowding which forms one of the evils associated with large centres of population. The total length of tram-lines open on June 30th, 1903, was 124½ miles, representing an expenditure of £3,371,587 for construction and equipment, the number of passengers carried during 1903 being 130,405,402. The Melbourne system, embracing a length of 48 miles, 43½ miles of which are worked by cable, and 4½ miles by horse-power, was constructed by a municipal trust at a cost of £1,705,794, and is leased to a company. It is said to be the largest and best cable system in existence. The number of passengers carried during the year was 47,564,942. There are also several suburban lines worked by limited liability companies as follows:—horse 8½ miles, electricity 4 miles, and cable 2¼ miles. In Brisbane the tram-lines were originally worked by horse-power, but in 1897 it became replaced by electricity, the tramways being the property of an English company, and covering a total length of 28 miles. As the traffic increases, extensions are effected. At the close of 1902 there were in the State 65 miles of tramways, including those in Brisbane, the number of passengers carried during 1903 being 18,125,302. In Adelaide there are several tramway lines worked by horse-power, but an attempt is being made to secure the introduction of the electric system. The lines are owned by private companies. In Western Australia, Perth has a well-organised system of electric tramways, which, like that in the Kalgoorlie Municipalities, is the property of a private company. Freemantle and Boulder City also will shortly be in possession of electric tramway systems, constructed by private enterprise under municipal supervision. The only state-owned tramway is that running between the

* Contributed by Mr. John Plummer, Sydney, New South Wales.

port of Roebourne and the town of Cossack, a distance of 8½ miles, in the north-western portion of the State. In Tasmania, the Hobart tramways are worked by electricity, and extend a distance of about 9 miles. They are owned by a private company, and were opened in 1901, in which year they carried 1,432,176 passengers. There is also a steam tramway in the north-west portion of the State, connecting Zeehan with Williamsford, a distance of 11 miles, its summit being 1,500 feet above sea level. Compared with other Australian tramway systems, that of Sydney is considerably the most efficient, there being a conspicuous succession of trams from early morning until midnight, an all-night service being established on several lines. During the earlier hours of the day and in the evening the tram traffic is enormous, the cars running almost every minute, being densely crowded. It is the same at holiday time, and the greater the amount of accommodation provided by the State Railway Commissioners the denser becomes the crowding. It is as if the whole population desired the use of the tramcars. Yet, with all this heavy traffic, accidents are comparatively few, being in most instances due to the disregerd of ordinary precautions on the part of the sufferers. All the Australian electric systems are on the overhead wire principle, which is not found to interfere with the work of fire brigades to anything like the extent originally anticipated. The cost of the New South Wales tramways was defrayed out of loan revenue, and they constitute one of the most valuable assets of the State.

THE VEGETABLE PRODUCTS OF THE EAST AFRICA PROTECTORATE.

East Africa has yet no predominating leading products of the vegetable kingdom, that is to say, its exports are made up of a great variety of products, no one of which can be definitely said to predominate, and the settlers do not yet seem to be quite certain as to which product will be the staple of the country. Potatoes at one time threatened to absorb the attention of the majority, and in the year 1903, 938 tons were despatched from the vicinity of Nairobi, which is the natural centre of this industry. The Assistant-Deputy Commissioner for the East African Protectorate, in an interesting report recently received from him says that unfortunately numbers of the potato growers lost heavily in their attempts to exploit the South African market, not through any fault in the tuber itself, but owing to the export trade being spoiled through bad handling, careless selection, and a general lack of experience in the business both on the part of the growers and their agents. The total export of potatoes has increased from £300 in value to, roughly £3,000. Great attention is being paid to the cultivation of cotton. Efforts, however, have not advanced much beyond the experimental stage. The best cotton crops are believed to be those at the Indian settlement at Kibos, where some 75 acres are under cultivation. A quantity of seed has also been distributed among the Kavirondo chiefs, and the crops look very promising. Several settlers in the direction of Fort Hall have tried patches which promise well, and fairly good samples have been grown in Kikuyu and around Nairobi. These samples were examined by the British Cotton-growing Association, and priced at 5½d. to 6d. per pound. The seed was Egyptian. The castor oil plant exists in a wild state over a great part of East Africa, and its cultivation should, therefore, prove easy. The seed is worth £8 to £9 10s. per ton. There is a fairly large local market for the oil, owing to the demands of the railway. There are large areas between Voi and Makindu where Sanseveira and aloe fibre are to be found in a wild state. A European firm has lately taken a lease of land near Kibwezi for the purpose of working them. An American firm has taken up an area for the same purpose on the river Tana, and is proposing to invest a considerable amount of capital in the undertaking. The fibre, properly prepared, is quoted at nearly £30 per ton. Among those who have any knowledge of Rhea fibre, the general opinion is that it will flourish in the Protectorate. One planter has grown a considerable quantity near Nairobi, and is now offering cuttings and plants for sale. It is a quick-growing plant, and it should not take long to prove its success on a large scale. The processes of decortication, cleaning, and bleaching, however, are said to require considerable outlay in machinery. Sisal hemp is a product of the aloe family, and it appears to grow well round Nairobi and in other localities. It is easily grown, easy to prepare, and the cleaned fibre commands a good price. Mauritius hemp has also been proved to grow well. It will flourish on almost any soil, and is easy to prepare. Ground nuts are being grown by the natives in various parts of the country with great success. The price of this product is, however, low, and a settler wishing to grow nuts at a profit must, therefore, cultivate them on a large scale, using machinery as much as possible. The only enemy of the ground nut appears to be a burrowing mole which eats the nuts before they reach maturity. Both wheat and barley grow well in any part of Kikuyu, and also on the Nandi and Lumbwa plateau. There is a considerable local demand for wheat, and there is said to be no reason, given a sufficient supply to pay for local milling, why local flour should not supply the whole of the east coast, both the Protectorates and Zanzibar. There is an extensive market for a good class o maize in South Africa, and many of the settlers in East Africa have considerable areas of South African and American seed under cultivation. The long red native bean of Kikuya and Kavirondo is in great request in Europe and South Africa, and attention is being devoted to its cultivation. Tobacco grows luxuriantly in Kikuya, Nandi, Lumbwa, and Kair-

rondo, and is largely used by the tribes inhabiting these places. So much, however, hinges on the expert curing of the leaf that it is impossible to say whether the native plant has any commercial value. Sugar-cane flourishes in Kikuya and Nandi, but it is not expected that the country will be able to do more than produce enough for local consumption. In coffee, experiments up to date have been fairly successful, but the present output cannot be considered as being on a commercial scale. What has been produced has been formerly reported upon. The growing of English fruits is being carried on with some success near Machakos, and there is an increasing market for fruit along the line of the railway. Experiments in sericulture have been conducted during the past two years in the Kenya Province. Several hundred mulberry trees of the Japanese variety have been raised. They are evergreen, and produce three or four good crops of leaves per annum. Silkworm's eggs have been introduced from France, and the worms have flourished exceedingly, the mortality in rearing being only one per cent. The silk produced has not yet been valued.

UNITED STATES RAILWAYS.

The report on United States railways, drawn up by the Hon. Robert Collier, Third Secretary to His Majesty's Embassy at Washington, and recently issued (Cd. 2237), contains a specially interesting review of American railway affairs. On June 30, 1903, the latest date for which returns are available, the total railway mileage in the United States was 207,977, and of this more than a third lies in the territory nearest the Great Lakes, bounded on the south by the Potomac and Ohio, and on the west by the Mississippi. The area of this territory is roughly a seventh of the total area of the United States (excluding Alaska), but half the population are found there, while 16 out of the 21 largest cities are within it, and three more on its borders. The capital invested in the railways of the United States in 1903 had reached a total of £2,624,997,970, 51·14 per cent. of which was funded debt. In the same year dividends at the average rate of 5·70 per cent. were paid on 56·06 per cent. of the stock invested. The gross earnings of all the railways amounted to £396,009,772, and over 70 per cent. of this revenue came from the goods traffic. Except in the extreme north-east, and the far west, the passenger revenue is nowhere more than 24 per cent., nor the goods revenue less than 70 per cent., of the total earnings. The total working expenses were £261,987,261, about 21 per cent. of which was devoted to the upkeep of the road and works, 19 per cent. to the upkeep of rolling stock, 56 per cent. to traffic expenses, and rather less than 4 per cent. to general expenses.

Railway servants are paid more wages than in this country, but the cost of living is a good deal higher. In 1903 there were 1,312,537 railway officials and servants of all classes—639 for each 100 miles of line. The increase during the last few years has been remarkable. In 1897 the total number employed was only 823,476, or 449 for each 100 miles. The highest paid class of railway servants are the train men. The average wages of a driver appear to be about 16s. a day, of a train conductor, 13s., and of a fireman, 9s., but as these men are paid according to distance, and not by the day, it is difficult to arrive at a very exact estimate. Station men ordinarily receive from 6s. 6d. to 7s. 6d. a day, signalmen and gangers about 7s.; plate-layers about 5s., and fitters and artisans employed in the shops 7s. to 9s. 6d. Not much has been done towards helping railway servants to secure dwellings, and only a few railways have established funds for providing their servants with sick pay, or with old-age pensions.

Each of the States of the Union imposes taxes upon the railways within its territory, and the Federal Government also receive a small duty. The different States levy taxes on the railways in different ways. For the year ended June 30th, 1902, the total amount of taxes paid by the railways was £11,346,966, of which only £300,647 was paid to the Federal Government. Much the greater proportion of this revenue is raised by taxes based on the value of the whole of the property of each railway, which is arrived at either by direct valuation, or, indirectly, by the valuation of the stocks and bonds, or some analogous method. In the year mentioned all the States raised the whole, or part of the taxes levied on the railways within their borders upon values arrived at by direct valuation, the sum thus received amounting to £7,778,473, and the present tendency is towards using this method more and more. Many States supplemented this by taxes levied on values arrived at by indirect valuation, and by specific taxes upon railway shares, upon gross or net earnings or dividends, or upon traffic.

There is no uniform scale for the whole country by which passengers' fares are determined. Much depends upon the maximum charges permitted by the laws of each State through which the railway runs. In the East the ordinary fare for a single journey is usually between 1d. and 1½d. a mile, often the former. For a return ticket reductions are sometimes made and sometimes not. The more a single ticket costs per mile the more likely is there to be a reduction on the return ticket. Suburban tickets are issued at a lower rate than others, and season tickets of various sorts are also issued. The New York Central Railway, for instance, issues "50-trip family commutation tickets" between New York and stations on its various lines, and some cases more than 100 miles away, at prices ranging from 30 to 40 times the single journey fare. Such a ticket is valid for a year, and may be used by the person who has bought it, or by any member of his family, or servant, or visitor of his. "Sixty-trip monthly commutation tickets," valid for one month,

and to be used by one person only, are issued at prices varying from 35 times the single fare for very short distances, to less than eight times the single fare for a distance of more than sixty miles on a line where the trains are slow, and the holders will, presumably, not use them very often. "Forty-six trip monthly school tickets" are issued to school children or teachers at prices calculated on the same amount per journey as the "Sixty-trip monthly commutation tickets."

There is, as a rule, only one class of ordinary passenger carriage, but most express trains contain "parlor cars" for travelling, in which an extra fare is charged. This supplementary fare is received by the railway company if they own the "parlor cars," otherwise by the Pullman Company, or some other independent company who have a contract with the railway company as to the running of the vehicles. The same is the case with the ordinary sleeping carriages (which are almost entirely owned by outside companies) for a berth in which an extra fare must be paid varying in amount according to the accommodation required, but in no case less than the corresponding "parlor car" supplement. A berth in a "tourist car," which is a sort of second-class sleeping carriage, costs half as much as a berth in an ordinary sleeping carriage. The extra fares are supposed to be calculated on a time basis rather than a mileage basis—8s. 4d. a night, and 4s. 2d. a day for the ordinary accommodation—but in practice the sleeping carriage supplement usually approximates ½d. a mile throughout. The "parlor car" supplement is in some cases considerably less than this, and in others about the same. Dining cars are usually owned by the railways. East of Chicago the ordinary charge for all meals is 4s. 2d. each; west of Chicago meals are generally served *à la carte*, partly because travellers in this part of the country have less money to spare, and partly because it is found possible by this method to feed more people in a given time. It is generally found there is no profit in the dining-car business. The regular free allowance of luggage is 150 lbs., each 100 lbs. of extra luggage being charged at the rate of 12 per cent. of the single passenger fare. Travellers with round-the-world tickets, or when about to start on long ocean voyages, get 350 lbs. free.

In the United States the standard gauge is, as in Great Britain, 4 feet 8½ inches. Flat-footed rails laid upon transverse sleepers, without the intermediary of chairs, are practicallay always used. The rails are laid with broken joints (*i.e.*, the rail joints on either side are placed exactly or approximately opposite the middle points of the rails on the other side). The distance from centre to centre of two lines of rails is 13 feet. The clear headway above the level of the tops of the rails is about 15 feet. The loading gauge of American railways permits of the use of rolling stock of large size. The extreme width is often more than 10 feet, and the extreme height of the chimneys of some engines is over 15 feet. Big modern engines with their tenders frequently weigh in working order as much as 150 tons. This weight spread over a total wheel-base of about 60 feet is by no means small, but when the weights put upon the driving and coupled wheels are considered, the figures are made more striking. Taking Mr. Collier's figures, eight-coupled goods engines have as much as 90 tons upon the coupled wheels, extending over a wheel-base of no more than 17 feet, and some four-coupled express engines have 27 tons upon the driving wheels and 25 tons upon the coupled wheels. The power of the boiler is commensurate with the weight of the engine, the grate area being often more than 50 square feet, and the total heating surface being 3,000 and 4,000 square feet.

Mr. Collier says that the passenger trains are frequently heavy—between 300 and 450 tons—but, with certain exceptions, not particularly fast. The best speeds are found between Philadelphia and the seaside resorts of Atlantic City and Cape May, where in summer there are a certain number of really fast trains. From Atlantic City to Camden (a suburb of Philadelphia) *via* the Philadelphia and Reading line, one train in the summer of 1904 was for a time given only 49 minutes, start to stop, for the 55½ miles, while between Camden and Cape May, on the Pennsylvania Railway, there is a train which covers the 72·2 miles from Camden to Anglesea Junction in 73 minutes, start to stop. Between New York and Washington, through a thickly-populated district, and past the great cities of Philadelphia and Baltimore, a very good service is called for. There are two lines engaged in this traffic; the distance in both cases is approximately 227 miles, and it includes a ferry crossing into or from New York involving a loss of about a quarter of an hour. From New York to Washington there are 15 trains each day by the Pennsylvania, and 10 by the Baltimore and Ohio. The fastest takes 5 hours. There are three trains at this speed, and seven more in 5½ hours or less. A certain number of these trains perform start-to-stop runs at average speeds of over 50 miles an hour. On the New York Central route between New York and Chicago the "20th Century Limited" covers the whole 980 miles in 20 hours in either direction. There are a considerable number of trains making start-to-stop runs at over 50 miles an hour, and the "Empire State Express" even performs two runs at over 57 miles an hour. An examination of the time tables of other lines shows a certain rather restricted number of runs at 50 miles an hour or more. A considerable number of runs of 100 miles or more without a stop are performed. Further west the trains get slower and less frequent. The Illinois Central have three trains a day from Chicago to New Orleans, the fastest running at an average speed (including stops) of 35 miles an hour, and the Northern Pacific have two trains a day from St. Paul to Portland at rather less than 30 miles an hour.

Mr. Collier's report touches upon a variety of

topics—upon finance, Inter-State and State commerce commssions, signalling arrangements, electric traction, the making up of goods trains, railway accidents, safety legislation, brakes, automatic couplers, and much else of interest and importance to all concerned with railway affairs.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in January and February, 1905:—

New Charts.—2076—Scotland, north coast:—Loch Eriboll. 3466—Germany. Jade river:—Wilhelmshaven. 180—Sicily: —Taormina road. 3473—West Indies. Cuba, south coast:—Santa Cruz del Sur and approaches. 146—Africa, west coast:—Niger river (Nun entrance). 3478—Africa, west coast. Niger river mouth:—Brass river. 3476—Bay of Bengal:—Naaf river. 3475—Philippine islands. Luzon, south-east coast:—Matnog bay and Tiklin strait. Port Gubat. 1764—China, east coast:—Amoy, inner harbour. 994—Japan. Nipon, south coast:—Yeboshi bana to Anori zaki, including Gokasho ko and Hamashima ko. Hasama ura. 3472—Japan, inland sea:—Ujino ko. 2401—Sea of Marmara. Plan added:—Beikos Umur and Buyukdéré bays. 2074—Mediterranean sea. Cyprus. New plan:—Kyrenia. 435—West Indies. Cuba. New plan:—Port Escondido. 2772—Eastern Archipelago. Anchorages in Gillolo. Plan added:—Loloda bay. 1394—China sea. New plan:—Entrance to Kuantan river. 2467—New Guinea. Plans and anchorages on the north coast. New plans:—Jamna road. Anus anchorage. 1510—Pacific ocean. Sandwich islands. Plan added:—Hanapepe bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—Index charts. A to V (omitting R). 1686—England, west coast:—Padstow bay. 2704—Ireland, west coast:—Blacksod bay. 1773—Ireland:—Queenstown and port of Cork. 2251—Baltic sea. Sheet II.:—Kalmar sound, &c. 2728—Spain, north coast:—Bidassoa river to cape Peñas. 1053—Spain, North-west coast:—Cape Peñas to Pontevedra bay. 689—Spain:—Gibraltar harbour. 366—Cape Verde islands. 565—Iceland, western portion. 321—North America. Lake Superior. 1148—West Indies. Leeward islands:—Ponce harbour. 2463—Alaska:—Port McArthur to Windham bay. 2462—Alaska:—Windham bay to Icy cape. 2461—Madagascar:—Nosi Vao to Purdy sand. 2871—Madagascar:—Nosi Bé, southern anchorages. 492—India, west coast:—Aguada to St. George island. 821—Bay of Bengal:—Elephant point to Chedúba strait. 823—Bay of Bengal:—Koronge island to White point. 824—Bay of Bengal:—White point to Mergui. 923—Eastern archipelago:—Botavia roads. 2578—Philippine:—Eastern part of the Sulu sea. 1262—China, south coast:—Hongkong to gulf of Liau-tung. 1199—China, east coast:—Kue shan islands to the Yang tse Kiang. 1602—China, east coast:—Approaches to the Yang tse Kiang. 1236—China, north coast:—Approaches to Port Arthur, &c. 2412—Japan:—Amoy to Nagasaki. 358—Japan:—The western coasts of Kiusiu and Nipon. 3254—Australia, north coast:—Norman river entrance. 2747—Australia, south coast:—Entrance to Port Phillip, &c. 1069—Australia, east coast:—Port Jackson. 1022—Pacific ocean, islands and anchorages in.

These charts are issued by Mr. J. D. Potter, 145, Minories.

THE VARIABILITY OF MODERN AND ANCIENT PEOPLES.*

In has been generally supposed that modern peoples deviate more widely than ancient peoples from their respective means. The writer's investigations upon the Egyptian fellahin, however, lend no support to this supposition, alike in length, breadth, and horizontal circumference of head and in cephalic index. The variability of the modern population of Kena and the neighbouring district is not sensibly different of that of inhabitants of the same region six or seven thousand years ago, as deduced by Miss Fawcett and others from the Nakada collection. So, too, the variability in cephalic index of ancient Bavarian skulls is found to be almost identical with that of the modern Bavarian population; and the variability of the cephalic index in modern French and English does not exceed, but is probably less than, that in ancient Gaulish and British skulls respectively.

More evidence is urgently needed, but what little we have supports the contrary hypothesis that modern and ancient populations living under like conditions of country and climate differ little in variability. Professor Karl Pearson, on the other hand, supposing that a diminishing struggle for existence encourages the persistence of individuals showing greater variability, believes that variability increases with increasing civilisation. The opposite view, however, appears tenable, that stringent selection encourages greater variability. It explains why in several features the oppressed Copts show greater variability than the Mohammedan population of Egypt, and the Whitechapel series of skulls of the 16th century is more variable than the general upper middle and upper class population of modern England. The more prosperous community tends to homogeneity; in other words, to regression towards its mean.

* Abstract of paper read before Section H of the British Association meeting at Cambridge, by C. S. Myers, M.D.

PHOTOGRAPHIC CHEMISTRY.

In his last Presidential address to the Royal Photographic Society, Sir William Abney, speaking of the progress which had been made in three-colour photography, said:—The advent into the market of two such extraordinary sensitisers as pinachrome and homocol will probably make the year a memorable one. The latter is the newest offspring of the chemist, and has yet to be investigated in a quantitative manner, but the qualitative examination of it shows that it has capabilities which no single dye has yet shown. He (Sir William Abney) had already published in the photographic press the conditions necessary to obtain an ideal photographic plate for the three-colour process, and shown that it is not the same as those necessary for perfect monochromatic work where colour luminosity is represented by various luminosity in black and white. The ideal three-colour plate then will be a separate entity from that of the ideal orthochromatic plate. It appeared to him that in the near future we may have the means of attaining closely these ideals even if we have not got them already. There is one thing, however, that he should have wished, and that is, that these new sensitisers might have come from British factories rather than from German. Had we fostered technical education amongst the middle classes in the past, as we are now endeavouring to do, we might have looked at home for the production of such sensitive derivatives. As the aniline dyes were first born in England, it is bitter to think that for want of trained men nearly the whole of these industries have left for foreign shores. But we have to thank our foreign chemists for having given to the world these products of their research. It is better to have them now than to have to wait unlimited time, till our home industry and research have revived.

TURKISH PREPARATIONS FROM GRAPE JUICE.

In Turkey considerable attention is devoted to the preparation of various articles from grape juice which are used as comestibles and are put up in a very convenient form for use when travelling. These are as follows:—"Basduk," in the manufacture of which freshly expressed grape juice is evaporated down to the consistency of molasses—a considerable amount of flour or starch is mingled with it and the mixture is spread in thin sheets upon cotton cloth and exposed for two days in the sunshine. After drying, these are then removed from the cotton (a damp cloth being applied to the reverse side in order to loosen the sheets), and for three months they are preserved in tightly closed jars. After this period there seems to be no risk of decomposition in the product, which resembles leather in pliability and appearance, the colour being that of the grapes employed at the outset. "Kesme" is another preparation which differs from the preceding in that coarse wheat grits are employed instead of flour and starch, and the resultant product is obtained in cakes half-an-inch thick, after drying on metal plates. It is less tough than the "basduk" and more savoury. In the preparation of "sujuk" (*rojik* in Armenian), walnuts are strung closely together on pieces of stout twine a yard long. These strings are immersed in the mixture of grape molasses and flour described above, and after receiving a coating about one-fourth of an inch in thickness are withdrawn and hung up to dry. The last two are preserved for a few months in jars, as in the case of the "basduk." These three preparations are said to be excellent articles of food, the last two being especially savoury. They offer much nutriment in a compact form, and are exceptionally well adapted for the needs of the Oriental traveller.

OBITUARY.

General Cooke, C.B.—Lieut.-General Anthony Charles Cooke, a life Member of the Society of Arts since 1883, died on the 6th April, at his residence in London. He was born in 1826, the son of the Rev. R. B. Cooke, Canon of York, and was educated at Southwell and the Royal Military Academy, Woolwich. He joined the Corps of Royal Engineers in 1844, and was director of the right attack at the Siege of Sebastopol in 1854. He was executive officer of the Topographical Branch of the War Office 1859-69, and commanded the Royal Engineers in Bermuda 1870-73, and at Alexandria 1873-78. He served as Director-General of Ordnance Survey of Great Britain and Ireland 1878-83. He was Colonel-Commandant Royal Engineers since 1900, and edited the Aide Mémoire for the Corps of Royal Engineers.

THE LIBRARY.

The following books have been presented to the Library since the last announcement:—

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Barlow, Glyn, M.A.—Industrial India. Madras: Natesan and Co. Presented by the Publishers.

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Clausen, George, A.R.A.—Six Lectures on Painting. London: Elliot Stock. 1904.

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Kerr, John G., LL.D.—Constructive Geometry. London: Blackie and Son, Ltd. 1904. Presented by the Publishers.

Laking, Guy Francis, M.V.O., F.S.A.—The Armoury of Windsor Castle. European Section. London: Bradbury, Agnew and Co. 1904.

Lehfeldt, R. A., D.Sc.—Electro-Chemistry. Part I. General Theory. London: Longmans, Green and Co. 1904. Presented by the Publishers.

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————The Science of Civilisation. London: Wm. Hutchinson and Co. 1903. Presented by the Author.

Ricci, Luigi.—Italian Grammar for English Students. London: The Walter Scott Publishing Co., Ltd. 1904.

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Winch, William H., M.A.—Notes on German Schools. London: Longmans, Green and Co. 1904. Presented by the Publishers.

GENERAL NOTES.

ALCOHOL COMMITTEE.—The *Standard* of the 12th inst. gives the following anticipations of the Report of Committee on the Industrial Uses of Alcohol. The evidence taken by the Alcohol Committee, whose report is now in the hands of the Chancellor of the Exchequer, will be found to have been strongly in favour of the remission of the duty on spirits employed in various textile manufactures. It was directed towards the recall on preferential terms of a large number of trades which have been abandoned in this country owing to cheaper methods or more liberal encouragement abroad. It will be found, we believe, that the recommendations of the Committee favour the balance of the evidence, and suggest the removal of many restrictions which have been brought to light by the inquiry. In Germany, alcohol used in local manufactures is duty free. In England, the duty is legally recoverable by the manufacturer on "making out a case" for the Inland Revenue. It is a curious feature of the recent investigations that this latter fact seems to have been unknown to the manufacturers themselves. Thus the various industries using alcoholic spirit may, quite apart from the Committee's report, should it touch the point, seek exemption from the duty if they simply use their powers under the Act.

SUGAR AND THE CONVENTION.—In his report for 1904 on the trade of the Netherlands, just issued (No. 3331, Annual Series), Mr. Consul Robinson refers to sugar, and makes some observations that may be read with interest. The past year was one of considerable importance to the sugar trade of all European countries, being the first year of the application of the Brussels Sugar Convention. The ultimate consequences, says Mr. Robinson, "cannot as yet be entirely appreciated for the reason that it came into operation simultaneously with a large deficiency in the beet root crop. An active and extensive speculative demand sprang up in consequence, and the prices of both beet and cane sugars have been considerably advanced." Beet sugar, quoted at about 8s. 4¾d. per cwt. at the beginning of the year, closed at about 14s. 5½d. on December 30. Cane sugar from Java rose from 9s. 3d. per cwt. to 15s. 3d. per cwt. in the same period. "The part played by the Brussels Convention in this connection," says the consul, "appears to many competent observers to have been unduly exaggerated; they express the opinion that the probable effect of the deficient crop has been immediately exaggerated by an army of speculators working on the apprehensions of the public, and that the coming into force of the Convention would, apart from simultaneous deficiency in supplies, have had but a comparatively insignificant effect on prices."

DEVELOPMENT OF AGRICULTURE IN THE MALAY PENINSULA.—It was decided at the last general meeting of the Malay Peninsula Agricultural Association, to offer two prizes for essays on "Rubber, its cultivation, mode of tapping and manipulation," one prize to be for Para Rubber, and the other for Gutta Rambeng. The Government last year inaugurated a series of agricultural shows, the next of which is to be held at Penang, in August next. In view of the scarcity of Indian coolie labour, the question of getting labourers from Java was mooted.

COOLIE LABOUR IN FIJI.—According to the Annual Report on Indian Immigration for 1903, the experiment has recently been tried of sending coolies to Fiji from Madras instead of from Calcutta. The general results have not been satisfactory by reason of the fact that during the first eight months the percentage of sickness among Madras immigrants was much higher than is usual among new arrivals, while their wage-earning power was about one-fourth less than the average of other immigrants on the same estate.

INDIAN STEEL.—According to advices from Calcutta, the production of rolled steel in India on a commercial scale from indigenous material has recently been effected by the Bengal Iron and Steel Company, at their Barraker works. At present some 500 tons of structural steel are produced, but large rail rolling mills are contemplated for the purpose of supplying the Government and other railways. At present 1,000 tons of pig-iron are produced each week, part of which is used by the Bengal Iron and Steel Company itself for railway sleeps, cast-iron pipes, columns, &c.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 17...Optical, 20, Hanover-square, W., 8 p.m. Mr. A. J. Bull, "Some Notes on the Nature of Vision."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Mervyn Macartney, "Garden Architecture."

Actuaries, Staples Inn Hall, Holborn, E.C., 5 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. J. M. Peebles, "Essays on Immortality."

TUESDAY, APRIL 18...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Annual General Meeting.

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, APRIL 19...Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. W. H. Dines, "An Account of the Observations at Crinan in 190 , and Description of a new Meteorograph for use with Kites." 2. Dr. Hugh Robert Mill, "Rate of fall of Rain at Seathwaite."

Geological, Burlington-house, W., 8 p.m.

Chemical, Burlington-house, W., 5½ p.m. Mr. W. C. Ball, "Complex nitrites of bismuth."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. A. E. Conrady, "The Application of the Undulatory Theory to Optical Problems." 2. Exhibition of Pond Life

Sanitary Engineers, 19, Bloomsbury-square, W.C., 7 p.m. Mr. E. R. Palmer, "The Ventilating, Flushing, and Cleansing of Sewers and Drains."

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FRIDAY, APRIL 21, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 4, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday Afternoon, March 28th; The HON. SIR JOHN ALEXANDER COCKBURN, K.C.M.G., in the chair.

The CHAIRMAN said he was very proud of the honour, as a member of the Colonial Committee, of introducing Mr. James, the Agent-General for Western Australia. Mr. James had a distinguished record in Australia, both as Premier of Western Australia and as a member of the Federal Convention. He was also one of the fathers of the Commonwealth, being present at the conference which framed and finally adopted the Commonwealth Constitution.

The paper read was—

THE MANUFACTURES OF GREATER BRITAIN. II.—AUSTRALASIA.

By THE HON. WALTER JAMES, K.C.,
Agent-General for Western Australia.

No question giving rise to comparisons between the work of one country and that of others can be satisfactorily disposed of unless, by the use of a few "fore words," those special features are referred to which indicate local conditions, and thus make fair comparisons possible. In few questions is this so much the case as in those affecting manufactures which depend for their growth not alone upon the total population of the country, but upon natural limitations or advantages which retard or stimulate production or distribution. There are certain features in Australasia which closely affect both production and distribution, and the mere enumeration of results can afford no real evidence as to the manufacturing energy of the people unless these conditions are known and appreciated.

GEOGRAPHICAL DIFFICULTY.

Australia has a population of 3,906,000, and New Zealand a population (exclusive of Maoris) of 800,000. If that aggregate population were comprised within the 105,000 square miles which represent the area of the latter colony, instead of being scattered over an area of 3,000,000 square miles, it cannot be disputed that the manufacturing results from the same number of people would be quite different from what they are or can be at present. There would then exist a relative concentration, both of manufacturing efforts and accessible markets, and so comparatively close a geographical connection between producer and consumer, that external supplies would have to confront greater and better organised competition whilst enjoying far less favourable conditions than those which exist to-day in the scattered population and wide-spread seaboard of Australasia. The present industrial position of the State of Victoria is perhaps the most advanced in manufacturing activity in Australia; and amongst other causes the main one has been its concentration of population in a comparatively small area and in readily accessible centres. These conditions have enabled the local manufacturer to capture the home market so fully that he has secured a firm footing upon which to build an extra-State trade which is rapidly growing.

Australia's area comprises very nearly

3,000,000 square miles; the 30 degrees of latitude through which she runs her length of 1,971 miles and the 40 degrees of longitude that cover her lateral expanse of 2,400 miles give every variety of climate, from temperate to tropical. Almost along the entire seaboard of this huge area is scattered her small population of less than 4,000,000 people; and though the main centres of population may be found in a limited number of localities, they are so widely separated that the manufacturer's market is almost as extensive as the geogaphical limits of the island, and to supply these centres entails an amount of seaborne transport that the home producer in no other country has to face.

New Zealand contains a population of 800,000, and her area comprises 105,000 square miles; and in her case also, though settlement may be relatively more concentrated than that of Australia, it is still so extended that the manufacturer finds himself under difficulties of the same kind though less in degree, in his competition with the oversea producer.

The scattered nature of the population of Australasia is inevitable when one bears in mind that the three main industries—Agricultural, Pastoral, and Mineral—are carried on at almost every part of the vast area, and carried on so vigorously that in 1903 Australasia exported domestic produce alone to the enormous amount of £60,417,000.

If one examines the map of Australia it will be found that in each State the main consuming and distributing centres are nearly all ports on the seaboard open to oversea vessels. In Queensland, Townsville, Rockhampton, Maryborough, and the capital, Brisbane, are the chief consuming and distributing centres and together contain a population of 170,000, and it is through these centres that the trade of the State is practically done. In New South Wales, Sydney and Newcastle together contain a population of nearly 600,000, and are both main ports through which the State receives its imports and from which the interior is supplied. In Victoria, Melbourne contains a population of nearly 500,000, and practically stands upon the shores of an over-sea port, through which nearly all imports into the State pass. In South Australia, Adelaide and Port Adelaide contain a population of 180,000 and serve as the great and almost only door to the import trade of the State; and again in Western Australia, Perth and the metropolitan area contain a population of 80,000, and all the import trade of the State passes through its doors, which are open to all oversea shipping. The same conditions apply at Hobart and Launceston in Tasmania, with a population of 56,000. In New Zealand the same conditions obtain, the main centres of population and distribution being Wellington with 50,000, Christchurch with 60,000, Dunedin with 53,000, and Auckland with 70,000; a total of 220,000 living at ports open to oversea shipping, and through which the great bulk of the colony's trade passes. Nearly all the chief centres of population which form the main markets of the manufacturer stand on or are directly served by oversea ports. In all these cases oversea manufactures are unloaded from the ships which bring them direct from the external manufacturers' works and land them direct into the main consuming and distributing centres of the local market. When one appreciates how comparatively light is the cost of sea-borne transit on long voyages in large steamers not bound to time, it will be seen that, so far as natural protection is concerned, the Australasian manufacturer's main market is, under present conditions of small and scattered population, just as open to oversea productions as to his own. At present, moreover, Australasian manufacturers are principally established at ports, and as a consequence both local and oversea producers meet at the common starting-points from which distribution has to be effected. The same railway journey and the same charges for internal distribution meet both competitors when once the goods are landed. The Australasian manufacturer, with his main markets situate at or immediately served by widely-separated oversea ports, and his main manufacturing works similarly situated at ports, finds that at all these ports oversea shipping calls regularly and constantly, and the stream of oversea importation thus flows past the very doors of his factory.

Inter-State Distances.

The Australian manufacturer who desires to capture the Commonwealth market has to allow for long sea journeys. Townsville is five days' sea trip north of Sydney; Melbourne, Adelaide, Perth, Hobart and Launceston are from two to nine days' sea journey south-west from Sydney; Wellington, Christchurch, Auckland and Dunedin are likewise separated from each other by a sea voyage of 20 to 36 hours' duration, and it is upon these sea distances that the manufacturer has to calcu-

late. It will be readily realised that such great distances separating the Australian manufacturers from the Australian consumers create a serious handicap in supplying so comparatively limited and so very scattered a market, whilst on the other hand such features offer great advantages to the oversea producer who, from one steamer on the one voyage, drops his goods at Perth, Adelaide, Melbourne, Sydney and Brisbane, and often does the same in New Zealand. As between Australia and New Zealand there is a distance of five to six days, and local manufacturers in each country competing for the trade of the other have to face that handicap of distance as well as the barrier of protective duties. These geographical difficulties, which stand in the way of the effort of the Australasian manufacturer to capture his own market, do not exist in Canada. The external trade has but few inlets open to deep sea vessels, and these inlets are not separated by distances so great as that between Brisbane and Perth. The internal trade is distributed from centres very widely scattered and situated many miles from oversea ports, requiring days of railway or canal journeying, whilst it is served by factories which are themselves placed far inland. The oversea producer has not only to face the cost of his sea journey but the far more serious charge of a long inland trip before he reaches his market and his competitor. He then commences to compete at a handicap measured by sea freight plus handling and internal transit charges; with us the latter charges are common to local and oversea manufacturers.

The difficulties which I have referred to, though considerable to-day, are not of permanent importance; as population grows and the volume of local manufactures increases the market of each State will encourage and justify more wholesale and less costly methods of supply and distribution. In the discussion and consideration of the present state of Australasian manufactures it should also be borne in mind that the

Age of the Australian Manufacturing Industry

is rather under four years. It was only made possible in October, 1901, when the old Inter-State tariffs were abolished and a Commonwealth Customs Act adopted. That was the first date on which an Australian trade could exist, and was the first inducement offered local manufacturers to build up factories and establish methods capable of supplying and suitable to the requirements of the Commonwealth. Prior to that date there were six States, the largest of which contained a population of 1,500,000, the smallest a population of 172,000, and so strong was local feeling that (with the exception of New South Wales) every State treated the importations from its neighbour on exactly the same footing as it taxed imports from other parts of the world. There was no preference, all were treated alike, and there grew up such a feeling of inter-State antagonism, that for many years all movements towards federation were thwarted by the fiscal difficulties involved, and federation only became an accomplished fact when the native-born Australians determined to secure union before these antagonisms became fundamental. The Australian manufacturers to-day, therefore, are but the children of yesterday, and even yet there has been no time to establish those larger works and to adopt those wider business methods which the expanded openings demand. Canada secured unity in 1867, and, from that time onward, the local manufacturer had a market as wide as the Dominion. In 1879 came his first real opportunity with the adoption of a national policy by Sir John McDonald, and for the past twenty-five years Canada has enjoyed a protective tariff which ensured to its manufacturers the control of Canadian markets. The real growth of its manufacturing industry is, however, of more recent date—some seven or ten years, and would appear to be due to the recent expansion of the far North-West and also to no inconsiderable extent to American capital and American management desirous of supplying the Canadian markets which are now opening. The first ten years of Australian manufactures will, I am confident, leave behind a much more striking record than that accomplished by Canada during the first twenty years of her protected Dominion market.

Mr. Just, in his paper dealing with the manufactures of Canada, states that *inclusive* of dairy factories the position in Canada in 1901 was as follows:—

Establishments	14,650
Capital invested	£93,000,000
Cost of material	£55,500,000
Value of products	£100,200,000
Number of employees	306,694

The position in Australasia *exclusive* of butter, cheese, and cream factories in 1902 was as follows:—

Establishments	15,364
Capital invested	£73,000,000
Cost of material	£53,000,000
Value of products	£92,000,000
Number of employees	248,735

These figures must not be taken as affording an exact comparison, as Canada appears to exclude factories employing less than five hands; in Australasia the State methods vary on this head, and apparently include factories containing less than five hands. On the other hand, Australasia excludes butter and cheese factories, and appears to show better results on the capital invested. I use the figures merely to indicate that the manufacturing energy of Australasia, despite its long wars of inter-state tariffs, bears no unfavourable comparison when brought side by side with Canadian results, after 37 years of federation and 25 years of a national and protected market, with much more effective natural protection and a much larger population than is enjoyed in Australasia.

New Zealand is industrially independent in the sense that she is fiscally at arms length from the Commonwealth. In that respect she stands to-day in the same relation to Australia that each State of the Commonwealth stood to the other before 1901. Her industrial development therefore will proceed on the lines of the past, benefited no doubt by the central and unified control of Australian Customs laws, but also not unaffected by the increased strength which Australian manufacturers will acquire from the possession of so much more extensive and valuable a protected market. Whether between the Commonwealth and New Zealand reciprocal trade relations will spring up it is difficult to foresee owing to the similarity of production, but it is impossible to believe that something will not be accomplished in this direction.

Australasia's Gross Production.

It will be gathered from these introductory remarks that the manufacturing development of Australasia rests with the immediate future under the freer conditions and wider markets now available; but the results already attained under the most adverse circumstances testify in a striking manner to the manufacturing activity of the country and the value of the Australasian market. The local manufacturer has a market far distant from centres of opposition, but yet so close to extensive oversea openings that few countries offer such inducements for the profitable application of manufacturing industry. Its geographical position should enable Australasia to control the great bulk of the Pacific trade. Its nearness to the East places it on more favourable terms than any other white people, whilst its distance of six weeks from its nearest competitor gives it in its home and external markets for manufactured goods an advantage which will remain a permanent factor in its favour. As long as external manufactures made by white people are being imported into the East there will continue to be openings for the Australasian factory, and in the competition for that trade there are many elements which tell in favour of Australasia immediately her factories have grappled with the home market. Until the States of Australia became united, no Australian growth of manufacturing industry was possible; no factory could exceed the demands of its limited market, and no foundation could be obtained on which to meet external competition. The few years which have passed since Federation, have already shown a marked expansion of local manufactures, imports have fallen from £37,800,000 in 1903, to £34,600,000 in 1904, although during the latter year exports increased by £9,600,000, and there are abundant evidences of the manufacturers' determination to meet the altered conditions brought about by Federation.

In December, 1903, the population of Australasia was upwards of four-and-three-quarter millions of people, an increase from four-and-a-half millions in 1901. Adopting these latter figures as being most complete for statistical purposes, the bread-winners numbered 1,979,484, and comprised 43·67 of the population; a percentage which disclosed an increase on past years, and is still growing. Of these 645,057 were primary producers, and 527,387 engaged in industrial occupations. Of this latter number 248,735 were employed in factories in different branches of the manufacturing industry,

The agricultural, mineral, and pastoral industries of Australasia are well known, and their great productiveness is apt to obscure the great manufacturing activity of the country; the more so as the manufactured article is consumed locally, and is not, therefore, so well known as Australian gold or wool, or New Zealand mutton or dairy produce. The total production of Australasia for 1902 was no less than £139,800,000, arising from the agricultural, pastoral, dairying, mining, forest and manufacturing industries. Of this sum the

industries named produced the following portions:—

	£
Agriculture	28,826,000
Pastoral	28,689,000
Dairying (including butter and cheese factories and creameries)........	14,274,000
Mining	24,954,000
Forest and fisheries	4,018,000
Manufactories (exclusive of butter, cheese, bacon, and cream)	39,048,000

For 1903 the total production has increased by seven millions.

This production of £39,000,000 was contributed to by the various States as follows:—

I.—Value of Production of Manufactories for 1902.

State.	Value of Production.	Value per Inhabitant.
	£	£ s. d.
New South Wales....	11,452,000	8 4 4
Victoria	10,734,000	8 17 10
Queensland	3,237,000	6 6 3
South Australia	2,883,000	7 17 10
Western Australia ..	2,423,000	11 16 5
Tasmania	1,389,000	7 18 2
Commonwealth	32,118,000	8 6 5
New Zealand	6,930,000	9 1 6
Australasia	39,048,000	8 7 8

Manufacturing Production.

It will be observed that, though the aggregate productions of the primary industries exceed the result from manufactories, the latter is by far the most important single industry, being eleven millions in excess of agriculture or pastoral, and fifteen millions larger than the returns from minerals. If the manufacturing figures were credited with the output of butter and cheese the result would be still more pronounced in favour of the manufactories output. This aggregate production is equal to £30 per head of the total population; being £21 12s. from primary industries and £8 7s. 8d. per head from manufactories. Of primary production Australasia alone produces from these heads in an ordinary year more per inhabitant than is produced from the combined industries of any other country; the Australasian production of £21 12s., being most nearly approached by Canada—£16 5s. 6d., United States £14 14s., and France £11 11s. 6d. It is not to be expected that comparative results so unique as these should be shown by an analysis of the manufacturing production of the country; great and energetic workers as Australasians have shown themselves to be, the productive power of so small a population is limited, and their pre-eminence in primary production on a capitation basis is, of course, the main factor in their gross productiveness. The manufacturing industry in its output of £39,048,000 has, however, a great record, and one which is profitable alike to the community, and to those directly engaged in it. As recording the value of the articles produced by the factories and indicating the profits derived from the industry, one finds that the total gross output of the factories (exclusive of butter, cheese and bacon factories, and creameries which are not dealt with under the head of manufactories, but credited to the pastoral industry) was £92,032,000, of which £52,984,000 represents the value of the materials and fuel used, and leaves £39,048,000 as the value added in the processes of treatment, and the output, therefore, properly credited to manufacturers. Of this sum of £39,000,000, £18,600,000 represent wages paid, and the balance of £20,400,000 remains as the manufacturers' profit, subject to rent, insurance, depreciation, &c. Whether that represents a fair profit or not I must leave to those who are more fully cognisant than I am of what manufacturers obtain or reasonably expect, but on that point some light may be thrown by some further statistics.

Comparative Cost of Manufactures.

The expansion of American trade of recent years has been so striking that numberless inquiries have been made with a view of ascertaining the reasons. Put shortly, the conclusion arrived at would appear to be: high wages and efficient workmanship, with new and labour-saving machinery and adequate exertion during working hours. The results achieved are too apparent to leave room for ignoring or discounting these factors, and as a consequence the American artisan and mechanic is extolled. Side by side with this admiration for the American is—to use a mild expression—a total want of appreciation of the Australasian workman. Yet the Australasian artisan is just as well educated, quite as intelligent, and just as hard, if not a harder, worker than his American cousin. I have met employers of various kinds of labour with experience of different workmen, and I have heard an almost general testimony to the Australasian worker. Side by side with

strongly-expressed criticisms of political questions—which are irrelevant in assessing the industrial value of a man's work—there has been no want of appreciation of his value as an industrious and intelligent worker. In this connection, Mr. Coghlan, the well-known statistician of Australia, has prepared a Table dealing with the cost of production in the manufacturing industries (excepting butter, cheese, &c., as already mentioned) in New South Wales, New Zealand, and the United States. He finds that the figures of New South Wales and New Zealand are substantially in accord, and in dealing with their joint figures takes the total gross output of these two countries from manufactories (£39,160,289), and shows that the expenditure incurred amounted to £33,342,071, made up as follows:—

	£
Value of materials	21,764,769
Fuel	725,428
Wages	8,379,507
Miscellaneous expenses	2,472,367
	33,342,071

leaving a balance of £5,818,218 which provides for interest on capital embarked and trade losses and profits. This latter figure represents 17·5 per cent. of all the items included in cost of production, or 14·9 per cent. of the value of the production itself. In other words, for every hundred pounds worth of goods produced in the factories of the two countries, the following were the proportions of the various elements included in the price of the goods as they left the manufactories:—

Materials and fuel	57·4
Wages	21·4
Miscellaneous expenses	6·3
Interest, provision for trade losses, profits, &c.	14·9
	100·0

The United States returns for 1900 give some figures dealing with the same subject, with this result:—

Value of materials used, including fuel	56·5
Wages	21·0
Miscellaneous expenses	7·9
Interest, provision for trade, losses, profits, &c.	14·6
	100·0

A study of these comparative figures should remove some widely entertained misconceptions as to the efficiency of Australasian labour, the percentage of labour cost in America and Australasia being almost the same. In such a comparison the results become more favourable to Australasia when the smallness of its factories and the consequent limitation of their turnover is compared with what exists in the States. Tables A and B annexed show the average wages paid so far as figures are available.

The general figures I have mentioned point to the great activity of the Australasian manufacturing industry, and show its cost of production and resulting profits; whilst the last comparison shows very clearly the efficiency of Australasian labour employed in that industry.

Trade of Australasia.

The total has grown much more rapidly than the population, and under normal conditions the commerce of Australasia per head is (excluding transit and re-export) only exceeded by one country in the world, namely, Belgium, and in our output of primary productions alone on a capitation basis we exceed the production from the combined industries of even that country. Including inter-state movements the Australasian imports during 1903 amounted to eighty and a quarter millions and the exports to nearly ninety-two and three-quarter millions, a total of £36 9s. 6d. per head. Of the total exports the inter-state trade represents £29,500,000, and the export trade passing to and from New Zealand amounts to £4,000,000, so that the export of Australasia to external countries amounts to fifty-nine and a-quarter millions. Of the total imports, £29,600,000 are inter-state and £4,500,000 represent the imports between New Zealand and the Commonwealth, leaving an import trade from countries outside Australasia amounting to forty-six and a-quarter millions. I do not object to the elimination from these figures of the inter-state and purely internal trade of the Commonwealth, but in estimating the trade of Australasia (*i.e.*, Australia and New Zealand) there is no reason whatever why the volume of it should be lessened by deducting the trade between the two fiscally and constitutionally independent States any more than there would be justification for treating the figures of the United Kingdom as if its imperial trade were local and internal. The correct way to place the figures therefore, is to eliminate local inter-state trade of the Commonwealth only with this exact result:—

Australasian exports for 1903 .... £63,130,542
,, imports ,, ... 50,600,146

giving a total external trade of £113,780,688. The import trade is almost entirely for local consumption; the re-exports being very limited. As regards export trade there is practically no export of goods manufactured from foreign materials. Of a total Australian export trade of £12 5s. 11d. per head, the exports which are not Australian produce, only amount to 13s. 3d. per head; the same results exists, I believe in New Zealand. The three primary industries of Australasia, pastoral (including meat and wool), mineral (including gold) and agricultural (including dairy produce) practically comprise the export trade of Australasia. Attention has been almost exclusively devoted to primary productions, and so huge an export from station, farm, forest, and mine fully accounts for the occupations and the remunerative employment of the people, and, at the same time, explains how infinitesimal a portion of our exports represent manufactured articles in the popular sense.

PRESENT MANUFACTURING POSITION.

There is a capital of £73,000,000 employed in the 15,000 establishments, in which the work is conducted throughout the country. The horse-power actually employed amounts to nearly 200,000, and the value of machinery and plant to upwards of £25,000,000. The number of hands employed in factories is about 250,000; the main centres of activity being in Victoria, New South Wales, and New Zealand, where population is more concentrated and numerous than in any other State. (The annexed Tables, C—G, afford more details under this head.) The average number of hands employed in factories is small, though several large establishments exist. But the smallness of the factory was enforced by the strict limitation of markets under the old fiscal systems of the separate States. The manufacturer of locomotives could not command a large market in 1,500,000 people; nor the hat maker in 1,250,000; nor the wine maker in 360,000 people; nor the pure woollen maker in 800,000. Already has begun the tendency to increase the size and output of factories, and the next few years should witness a great and beneficial change in larger factories with increased output at reduced cost.

The progress of the manufacturing industry in Australasia has always been irregular, and though the increase in hands employed since 1885 shows a growth proportionately much greater than that of the population, as a matter of fact the greater part of the extension has been due to the past seven or ten years, and this relative advance has therefore been still more marked. The following Table indicates this;—

II.—THE FOLLOWING TABLE SHOWS THE GROWTH OF THE FACTORIES SINCE 1885.

Year.	Establishments.		Hands employed.	
	Commonwealth.	New Zealand.	Commonwealth.	New Zealand.
	No.	No.	No.	No.
1885	8,632	1,946	105,265	22,095
1890	8,903	2,254	133,147	25,633
1895	8,247	2,459	133,631	27,389
1900	10,040	3,668	184,160	48,718
1903	11,979	3,960	196,424	52,628

The manufactures of Australasia are, however, as a whole domestic; they naturally arise from the circumstances of the population or are connected with the treatment of perishable products, but there are nevertheless a fair number of firmly established industries of a more complex character, *e.g.*, locomotive, tweed, piano, hat, billiard table, and paper factories.

Of the persons employed in factories, 13,000 are employed in the treatment of perishable products for immediate use, and 123,000 in industries dependent upon natural resources, there are 113,000 engaged in industries which to a greater or less extent come into competition with imported goods. The distribution of these factories is given in Table III. on p. 604.

Of those employed in competitive factories there are certain lines in which the local manufacturer must be always a producer, however great may be foreign competition, or however "free" may be the imports.

As the great bulk of Australasia's manufactures are domestic and not of articles manufactured for an export trade, a very short reference to them will be necessary; the main interest centreing at present in the wealth and productive activity shown by Australasia as a whole. Australasia imports all her iron for reasons I shall presently indicate; her exports of timber are of the undressed kinds; she does not at present grow cotton. Her exports, in which these lines form a part, would therefore be practically all re-exports, but the proportion which represents these items made into manu-

factured articles for export is so extremely limited that they are a negligible quantity. Practically speaking, there are no exports of machinery, cotton goods, or woodwork, and Australasia does not at present compete with the outside world in external markets except in connection with the products of her three primary industries. Australasian manufacturers desire to meet the local demands as far as practicable; they have yet much to do before that end is accompiished. When, however, that position is achieved in any main line, the question of an export of manufactured articles competing with the producers of other countries will become a practical one. In the meantime, it may for all practical questions be disregarded in the consideration of Australasian manufactures. In the references, therefore, I now make to certain main lines of import, I shall do so more for the purpose of indicating the large field of consumption which is open to the local manufacturer than any desire to be exclusive.

TABLE III.

State.	Employed in domestic industries for the treatment of perishable products for immediate use.		Employed in industries dependent upon the natural resources of the country.		Employed in industries, the production from which comes into competition with imported goods.	
	Males.	Females.	Males.	Females.	Males.	Females.
New South Wales	3,573	51	26,513	5,696	22,367	7,433
Victoria	3,490	43	20,772	13,730	25,172	10,022
Queensland	1,337	43	8,394	2,263	6,408	841
South Australia	794	11	6,717	3,106	7,192	824
West Australia	883	3	6,567	1,097	3,044	289
Tasmania	378	21	3,935	723	2,129	563
Commonwealth	10,455	172	72,898	26,615	66,312	19,972
New Zealand	2,441	52	21,173	2,029	17,408	9,525
Australasia	12,896	224	94,071	28,644	83,720	29,497

The following are a

Few Leading Lines.

Food and Drink (including stimulants and narcotics, and agricultural products and groceries).—The local factories deal with bacon, butter, cheese, and other dairy lines, meat and fish preserving, jams and fruits, biscuits, cornflour, cigars, tobacco, beer, and other such articles, employing altogether about 39,000 hands. There is a large export of frozen meat, of wheat and flour, and a large and growing production of sugar and molasses. The wine industry should provide one of Australia's greatest outputs, and there can be little doubt that the importation of still wines must fall off as the conditions of vine culture are better understood. The wine-making grapes grow to great perfection in a large part of Victoria, South Australia, New South Wales, and in Western Australia, though at present the chief output of wine comes from Victoria and South Australia. Unfortunately, the fact that any kind of grape could be grown has caused vignerons to spread themselves over all varieties. The experience arising from internal competition has now created a tendency to specialise, and as a result, where there is a specialisation and concentration of effort, the home trade is being captured, and there is good promise of large exports. The importation is even now being more limited each year to the very high-priced wines which enjoy a special demand. The possibilities of an extended export trade in this line are apparent, and the next few years will witness it.

The imports in the way of stimulants from Great Britain are mostly whisky lines and beer in bottles, or beer in bulk sent to Australia to be bottled before going on the market. In such a line as stout, "Guinness," bottled by various firms, has a monopoly of the market. The bulk brewing trade is wholly a home trade. Where Australian breweries are opening up a bottled trade, it is in the lighter brew which comes more into competition with German "Lager Bier" than with the British bottled trade, the latter being too heavy as well as too expensive for local tastes.

It may help to remove another misconception in relation to Australasia if I point out that its consumption of intoxicants compares

most favourable with European and other manufacturing countries. The consumption per head in gallons of proof spirit being :—

United Kingdom..........	3·57
France	5·10
Germany	3·08
Italy	3·40
Holland..................	4·00
Belgium	4·00
Scandinavia	4·36
United States	2·65
Australasia	2·30

These figures are still more favourable when the fact of the large preponderance of males over females is made a feature of the comparison.

Australian distilleries only employ 178 hands, and rarely operate on the open market. Their output is used for blending with Scotch or Irish whiskeys.

The imports under the head of agricultural products, &c., are large, and mostly comprise tin goods, principally fish. All the States are food growing and of the main staples (bread, meat and fruit), Australia exports largely. The only competition in these lines comes from special manufactures, and their volume has had some impetus of late years by the discovery of the Western Australian goldfields, on which there has been a large consumption of preserved foods. In this State trade the oversea supply has, so far, competed on equal fiscal terms, but the Eastern States now have the advantage of a free market, while the oversea producer will have a barrier in the uniform Australian tariff. As the restless conditions of Australia life disappear, local trade in all these lines, except perhaps tinned fish, should come into the hands of home growers. As an instance, Victoria has quite recently got control of her own dried fruit trade in all respects except currants, and is extending her trade in the other States, and South Australia is following the same lead. In any circumstances, where the main staples of the food supply are grown so cheaply as in Australia, settled conditions of life must drive out competition except in lines where some special feature is looked for. In many cases the English articles have the preference, because from want of capital to obtain plant and want of experience there has been a roughness about Australian goods under this head which has raised prejudices against them. An increasing trade and internal competition is, however, gradually eliminating this roughness by demanding a more careful production. It is, moreover, difficult to believe that Australasia's increasing agricultural development will not lead not only to a control of the local market in the articles manufactured from agricultural products, including all farm and dairy produce, but to a large and extensive export trade.

Under this division are included the meat and dairy production of Australasia. It was New Zealand that first opened this trade in 1882 with a small shipment, which by 1892 had risen to £1,091,262, and in 1902 to £2,685,960. In Australia the trade has been checked by the want of cross-bred sheep and the British prejudice against merino mutton. The export from the whole of Australia during 1902 (a bad year owing to exceptional droughts) only totalled £2,214,921. Under this division, too, comes the dairy produce, and of these lines in 1901 Australia provided 6·70 and New Zealand 4·52 per cent. of the total imports into the United Kingdom; a joint supply of upwards of 11 per cent., which placed Australasia as the largest supplier after Denmark. The falling off in 1902 was due to drought, but should be restored now that normal seasons are being enjoyed. That Australasia can with such articles compete in the markets of the world, notwithstanding a journey of six weeks, gives some indication of what can be done when other portions of farm and agricultural produce are taken in hand and prepared for export; *e.g.*, cheese, bacon, biscuits, dried and preserved fruits.

Apparel and Textiles. — Industries of this class afford more employment than any other, there being about 55,000 hands engaged in factories. The use of machinery, however, is not so extensive as the number of hands employed would imply. The factories deal with wool, hats, slop clothing, and other such products.

Our importations of woollens amount to £1,458,735, although we are one of the greatest wool-producing centres of the world In woollen mills in Australasia some 3,500 hands are employed, about half of whom are in New Zealand. The consumption of wool in these mills is about seven million pounds, and the output comprises two and a-half million yards of tweeds and cloth; four and a-half million yards of flannel; 130,000 pairs of blankets and 34,000 rugs and shawls, of a total value of £360,000. New Zealand also has 1,700 hands employed in flax mills; in no other State has this industry been established. As Australasia exports £18,000,000

worth of wool per annum and imports part of that same wool again after a journey of 32,000 miles in the form of clothing, &c., to supply her wants, it is difficult to avoid the conclusion that the question of her taking possession of her home woollen trade with the exception of high-class goods of limited demand and special make can only be a question of time. The dregs of the gold fever and the effects of the opening up of new agricultural and pastoral lands is still in the blood of Australians, and the maufacture of woollens is only now being seriously faced. As a higher class machinery is fitted in the mills, and the system of running the mills by inexpert boards of directors is cut out, the home trade in woollens with the qualification named is bound to overtake the supply. At present the Australian manufacturer limits himself entirely to men's clothing, flannels, and blankets. No dress pieces are made. The home trade must be limited in such lines, as all wool materials must be made light to obtain a sale. Winter, except in colours and the putting away of the very light materials , does does not make much difference in general apparel except in some isolated, cold, mountainous parts. It would, however, be a mistake to take it for granted that cotton-growing is out of the question in Australia. There are vast areas suitable to the plant, and though the present tendency is to assume that labour conditions will make the industry unprofitable, the question is by no means determined, and the value of such a crop is so great in itself, and so much more so in connection with wool, that I firmly believe the near future will witness a most determined effort to make a success of cotton growing in the Commonwealth. The foreign trade in this line of apparel and textiles would be turned into British by a preferential tariff. The matter of the rate of the preferential tariff in the clothing trade would cause the bulk of Australians little concern.

Metals and Machinery.—Of our export trade, £50,777 is for agricultural machinery, and is one of the very few items where manufactured articles are exported; this export is due to special manufacture and patented rights. Works connected with the treatment of metals, manufacture of machinery, agricultural implements and railway rolling stock form, a large and growing class of industry. About 42,000 hands are employed at this work, and about £4,000,000 represent the value of the machinery in the factories, which turn out, amongst other things, railway locomotives and rolling stock, galvanised iron and wire, agricultural implements, mining plants and machinery, but, with the exception already mentioned, the output is to meet local demands, and all iron and steel used is imported. The local manufactures may be said to principally comprise very heavy foundry work, and goods for which sea carriage would be very expensive. In most cases where manufacturing successes have been made, it has been due to an understanding of special local conditions. A mine can be more cheaply equipped from an Australian foundry, because each mining field has its special requirements which are provided for by the local manufacturer; the same considerations apply to agriculture. "The Stripper" is an Australian machine, brought into being because in good seasons straw is a burden to the local farmer, and this machine cuts the heads and leaves the straw standing. Another machine, the McKay Harvester, designed on the Stripper principle, has built up an export trade to countries where agricultural conditions are similar to the Australian—chiefly South America, but as a rule the home trade in machinery may be taken to be the heavy foundry work and local specialities. As an instance of what is meant by special conditions, a small Victorian foundry has a large trade in picks with the Western Australian mines, because experience in the Victorian quartz mines had shown just where strength should be placed to get results. The pick was promptly copied by American competitors, but it was some time before any of the British travellers could get their firms to do so. It has, however, been copied by an English firm lately, after competition had made such advances that a change became vital if the trade was to be saved. Under this head the foreign competition against Great Britain is growing, chiefly from the United States of America, but also by means of a cheap cutting German trade. The trade now possessed by the foreigner would nearly all pass into British hands if a preference were imposed. The import from America of some of their main lines (*e.g.* electrical machinery) cannot be affected by local manufacture for very many years, and is therefore an open trade for oversea competition, and the margin is so small that almost any preference would give an advantage which would secure the trade. The American trade, however, in agricultural machinery will

steadily be overtaken by Australian makers because local conditions are specially catered for. As an instance, the McKay Harvester Works at Ballarat cannot supply the demand for their machines, and each machine supplied takes the place of an imported reaper and binder.

Oil, Soap, Candles, Glass, &c. — We have about 1,800 hands employed in manufacturing soap and candles and 1,200 employed in glass works. Of soap and candles the output for 1903 was about twenty-eight thousand tons and six hundred and ninety-nine thousand tons respectively. Our exports are mostly of raw products such as oil and tallow. The oil imports are mostly in specialties and the home trade in earthenware is limited to the rougher work, and the home glassware trade to the everyday bottle of commerce. Of late years American glass, cheaper and flimsier, but made in imitation of the better English glassware, has been largely sold, and this is no unusual thing in manufactures. If the appearance of British makes can be got without the quality, the more durable and better made British article is frequently driven out. One Yankee drummer opened up a trade in carpets by introducing a carpet of Axminster patterns and appearance, but of admittedly inferior quality. "Life's too short for their kind of quality," the Yankee explained, "Mine looks as well, costs less, and will last till you get tired of it!" He got his trade.

Wood, Wicker, and Cane Goods. — Our export is mostly of undressed timber. We have 23,000 people directly working in wood, but probably the most of the 5,000 people working in "Furniture, Bedding, and Upholstery" should be added. The furniture trade is practically a home trade, but it is in a large part Chinese labour. Though Australasia produces various kinds of wood, admirably adapted to the requirements of the furniture trade, it can hardly be said that the trade has attained a development equal to its opportunities. The peculiarity of the Chinese is that they concentrate themselves on an industry; they have done so on furniture, and have practically taken complete possession of it. It is impossible to get any knowledge as to wages paid in the trade, and Factory Acts are dead letters to them. European workers say they cut wages. The Chinese say that they get high wages. Perhaps the truth lies in this, that they did cut wages to squeeze the white workers out, but now they have control they demand good wages. This Chinese labour cannot further expand, and even as it is a "strike" by Chinese workers in Melbourne a year ago showed that the working Chinaman whose labour has always been under the control of the "companies," whose headquarters are mostly in Hong Kong, are now getting out of control. A working Chinese is a strong supporter of a white Australia. He finds it suits him. As one put it to me—"Plenty here. More Chinamen come not so much tucker!" "Tucker" is food. The Trades Hall could not put the sentiment better. The Immigration Restriction Act must bring white labour back into the trade without causing any conflict with the Chinese now here, as a Chinaman once free from "Company" control soon realises the market value of his work.

Jewellery and Fancy Goods.—Of the export trade, gold and silver bullion and precious stones are the main factors, the export of jewellery, properly so-called, being very small indeed. We have 1,200 people engaged in our own trade, but of these some, no doubt, are principally employed in the repairs of watches and clocks. The British trade is small, owing probably to the predominance of American watches and clocks. Australia is too new a country to require much quality in jewellery, provided something reasonably good and cheap can be got.

Leather and Rubber (boots and shoes, but not saddlery and harness).—There are 15,000 people engaged in the boot trade who, in 1903, turned out 9,000,000 pairs of boots and shoes, and 500,000 slippers. The boot and shoe trade is one of the growing trades of Australia. In some States the Australian trade holds the market, and since Federation it is expanding in other States. The import trade is in infants' shoes and in adult boots of very good quality. Curiously, the infants' shoes beat the local market because of their cheapness and flimsiness, whilst the adult high-class boot beats the local market because of its good quality. The boots in which the oversea market finds the least competition are of the Northampton class. Lately the Americans have made strong efforts to capture the trade by establishing sub-companies which open retail shops. The bulk of the boot and shoe trade is sure to come under Australian control, though it is doubtful whether the factories will trouble for some years to compete with the trade now coming from Great

Britain in higher qualities. A preferential tariff would decidedly snuff out the American and German competition in the same lines, and thus double the existing British trade. For the local manufacturer there is a very large opening in all sorts of leatherware, the tanning industry being well developed, and last year turning out nearly 1,200,000 hides and four and a-half million skins.

Vehicles.—Here again special knowledge of Australian conditions count. Practically all vehicles properly so-called are home-made, because each district has its own peculiarities. The type of farm waggon varies in different districts. Australians are quick to learn, and in farming districts where the roads are either heavy from dust or from mud the value of the "Boer outrigger" to help the pull of the shafts was quickly seen and adopted when the returned soldiers spoke of it. About 7,600 persons are employed in these factories.

Sugar.—The exports of Australian sugar amounted to £22,366. The cane is grown in Queensland and New South Wales, but though slightly increasing in Queensland is decreasing in New South Wales. In 1903 there were 131,733 acres under cultivation; of the cane grown 423,302 tons were grown by white labour receiving a bounty of £90,770, and 628,084 tons by black labour. The Federal Parliament provides for the payment of a bounty of £2 per ton on all sugar produced by white labour. In 1903, 26,061 acres were registered as cultivated by white labour; for 1904 the acreage registered has increased to 56,289 acres. The Australian grown sugar represents 54·2 per cent. of all sugar locally consumed; the value of the cane crop for 1903 being £787,000. Forty-eight mills are in active operation and the capital invested in sugar mills represents some two and a half millions of money. About 2,000 persons are employed in this work.

Musical Instruments.—We produce pianos, and have employed in this work about 260 hands. The British values are not traceable, but so far as pianos are concerned the imports are nearly all German. The Australian firm which employs nearly all the 260 engaged in this work has, since Federation, made special efforts to obtain the local trade; the factory is most admirably equipped and has adopted the newest methods and machinery, and shops for retail purposes have been opened in all the States. Should this venture succeed in its determination to capture the bulk of the Australian trade, it will not only afford a most striking instance of what the local manufacturer and workman can do against the finest products of European and American workshops, but it will encourage similar efforts in other directions.

Nature of Exports and Imports.

I do not propose to follow every class of manufacturing occupation, but will content myself with the manufactures referred to. Those manufactures will show the main heads under which the future of our manufacturing expansion will principally lie.

Of the exports from Australia, totalling £48,170,164, specie and bullion account for £19,123,958, and merchandise accounts for £29,046,206. The total exports of Australian produce, £27,700,000, is for merchandise, and £17,800,000 for specie and bullion. Of the exports of merchandise, wool accounts for £13,997,000; coal and coke for upwards of a million; leather, half a million; undressed timber, £700,000; oils, £225,000; meat, £1,780,000; and butter, £1,200,000; fruit, £375,000. These items represent about £20,000,000, and are not exclusive, but quite sufficient to show that the exports of Australia are almost entirely of primary productions. Of the remaining sum of seven millions odd, quite half could, I think, be traced to the same source. Of the exports of New Zealand, amounting to £15,010,378, meat export accounts for £3,300,000; gold for £2,000,000; grain for £530,000; gum for £631,000; hides and leather, £150,000; butter and cheese, £1,500,000; flax, £600,000; agricultural and pastoral products (n. o. e.), £850,000; tallow, £465,000; timber, £240,000; wool, £4,000,000. These items also are not exclusive, though representing £14,000,000 of a total export of £15,000,000.

The imports on the other hand are almost entirely manufactured goods. Australia imported £36,500,000 worth of merchandise made up as follows:—

Stimulants and narcotics nearly	£2,000,000
Sugar	1,087,000
Agricultural products and groceries	7,094,000
Apparel and textiles	8,838,000
Metals and machinery	7,384,000
Jewellery and fancy goods	2,051,169
Oils and paints	1,243,000
Earthenware, glass, &c.	705,313
Drugs and chemicals	931,000
Wood, wicker, &c.	1,234,000

Leather, &c.	890,000
Paper and stationery	1,505,000
Vehicles, musical instruments and miscellaneous	2,297,000
And free goods	626,000

The imports of New Zealand amounted to £12 788,675, and, broadly speaking, show the same results as those of Australia.

The exports of Australasia may therefore be classed as primary products; the imports as manufactured products. The volume of import trade is so large that to secure even a substantial portion of the local trade will give to the manufacturer full scope for his efforts at present and an ample reward in the event of success. The Australasian market is altogether out of proportion to the population as the people are both great producers and great spenders, and their demands offers a splendid field of operation to the man who with capital and experience determines to cast in his lot with the manufacturers of Australasia.

General.

The conditions of the trade insist upon a ready adaptability, a willingness to meet the demands of the purchaser and an appreciation of the fact that a consumer wants to buy new goods not the manufacturer's old plant. The productiveness of Australasia shows its wealth and resources; its imports show its special value as a consuming market, while its geographical position opens to it certain external markets which the oversea manufacturer can enter only after a long sea voyage. The last two years mark an epoch in Australasian manufactures, and the next ten will amply justify the hopes of those who believe in Australasia's industrial development. The country possesses the two main factors of success. She has first-class coal, and she has large deposits of rich iron ores. She has wool, and she also has large areas suitable for the growth of cotton. Australia exports to external countries about a million tons of coal, and New Zealand exports nearly 200,000 tons; the industry is old and well established, and the quality of the coal well known. Iron ore is widely spread throughout both countries, and during the ensuing or next following session of the Federal Parliament provision will almost certainly be made granting a substantial bonus on the production of iron and steel from Australian ores in accordance with a recommendation made by a Royal Commission which dealt exhaustively with the subject. Australia cannot be said to possess water-power available for extensive industrial purposes, but New Zealand has this power so well distributed that she would appear to offer ideal conditions for those manufactures to which water-power is essential. Tasmania also has special capabilities in this direction.

Tariff.

The tariff of the Commonwealth is a compromise between the need for revenue and the demand for Protection, and it is needless to say that the result is satisfactory neither to Free Trader—a rapidly diminishing factor—or Protectionist. The passage of the tariff through Parliament occupied a whole session, and until September, 1902, the manufacturing industry was in a state of uncertainty which paralysed all progress. The Commonwealth tariff is lighter than that of New Zealand; it is lower in its average burden of duties than that of any separate State except New South Wales and Western Australia, and in some lines has had an appreciable influence in checking manufacturing expansion and in increasing imports. Of the total imports, exclusive of narcotics, 31·7 per cent. are of free goods and the average rate of duty on dutiable goods other than narcotics and stimulants is 19·7 against a prior pre-Federal rate ranging from 36·2 to 21·8 in four States and 10·3 to 14·8 in two States. If the Commonwealth tariff be compared with the tariffs of America or Canada, the results would meet the approval of the Cobden Club as it would by comparison appear free trade.

Industrial Legislation.

I do not enter into a discussion of the various Acts of Parliament which apply in the various parts of Australasia, and are known as "Labour Legislation." The great majority of these Acts are merely the adoption of reforms long advocated by the advanced public men in England; they are a recognition of the fact that whatever the State cannot do there is at least a very wide field of usefulness in eliminating some of the inequalities which exist and tend to impair the full value of industrial effort. The Industrial Arbitration and Conciliation Act is by far the most important, because so far-reaching and so novel. The father of that legislation (Mr. Reeve) is, I believe, present, and is quite qualified and able to defend it, but time will be its best indication.

Though temporary difficulties may and do arise, the growing influence of this Act upon public opinion tends to make strikes so impossible that it has already forced the settlement of at least one industrial dispute around which clung so much feeling that the Act alone saved a long and disastrous strike. Employers are rapidly adapting themselves to the changed conditions; the Act is receiving from them less opposition as its working is better understood, and the objections now raised are more due to the frequency with which the Act is invoked, and the too marked presence of industrial busy bodies than to any hostility to the Act itself. Most of the complaints to-day are almost inseparable from the first few years' working of so far reaching a piece of legislation, but those who appreciate how great are the issues involved, and how incalculable a blessing the success of this Act will be, should it replace strikes by arbitration, will watch its operation with sympathy and patience.

TRADE WITH THE MOTHER COUNTRY.

The conception of Empire as a division of labour in which the outposts shall remain primary producers of raw products and the Mother Country the sole centre of manufacturing industry is not one which commends itself to Australasians and the colonising spirit which made the Empire by its attachment to locality manifests itself in a determination to make the new home as complete and self-sufficient as is possible. In the prosecution of this aim there is nothing antagonistic or exclusive of mutual trade preferences; it is indeed but an application in detail of the wider principle. When the Empire, as a whole, is felt to belong to and to appeal to all as closely as Australasia appeals to its people, the adoption of imperial trade preferences will be but an extension of the principle which, at present, actuates Canadians and Australasians in their determination to encourage local developments. I offer no apology, therefore, for stating that though an ardent supporter of preferential trade, I am a strong believer in the need to re-adjust our Commonwealth tariff on lines more favourable to the local manufacturer. That action in this direction will soon be taken is apparent. A Commission has been appointed and is now sitting to consider the question of tariff amendment, and most probably Parliament will deal with the matter at its next session, and grant to the local manufacturer a more adequate protection than he now enjoys. Even then we are not likely to see a tariff with walls so high as those which surround America.

The trade of Great Britain with Australasia is proportionately less than formerly; the imports are now about one-third foreign as against one-fourth ten years ago. The exports show a somewhat similar trend. This is not all due to causes which the British manufacturer can prevent but those preventible causes account for a substantial part of this relative retrogression and the result is deplored by Australians more keenly apparently than by Englishmen; a fact which may be explained by the evidences of foreign encroachment being more manifest in Australia than in England where Australasian figures get lost in the huge totals of all trades. The Australasian deplores these inroads upon the commerce of the Mother Country just as he would feel—though of course in a greater degree—any military or naval reverse which affected her. The commerce and trade of England help to form that prestige in which all who belong to her Empire take such pride. In these days it is in the peaceful warfare of industry and commerce that are manifested the brains and energising power of a civilised people, and Australasians are too deeply attached to the Mother Country, too proud of the Empire's greatness to feel aught but regret at industrial or commercial retrogression which is none the less substantial because relative rather than absolute. It is from such motives that the desire for trade preference so largely springs. That a change so great implies the risk of failure may be admitted. Such consequences have to be faced by every individual and by every community to whom advance is vital. But a readiness to work together and a united effort to discover a satisfactory line of advance will go so far to minimise the chances of failure that nothing but the mere fear which always stands in the path of progress will allow possible risks to overshadow most probable gains. Believing, as we so largely do, that mutual concessions can accomplish so much to secure for the Empire the control of its own trade and the enormous expansion of its varied resources, it is not to be wondered at that Australasians almost unanimously desire to see an earnest attempt made to arrive at a scheme upon lines satisfactory to the moderate men on both sides without asking the acceptance of details. We are at a loss to understand why the very thought or suggestion of such a scheme should in England be regarded with such bitter opposition and resentment, that any attempt to

meet together and discuss the matter is anathematised by bell, book, and candle. Under the present Australian tariff, and in relation to the present Australian trade, there is room to divert to Great Britain many millions of imports which now come to us from foreign countries. Whatever tariff is adopted—and no great departures from our present tariff are immediately probable—there will always be a large and growing import trade which preference can affect. The growth of Australasia as a consuming market is bound to increase though the class of imports may differ. Whether therefore the position be judged by the existing tariff and available trade of to-day, or the probable tariff and increased trade of ten or twenty years hence, Australasia offers to the British manufacturer a market well worth having. Whether preferential trade by securing that advantage entails other and greater losses is the only question worth consideration. That question can never be settled when approached as if fiscal treason were involved in its mere expression. Our race has not yet been a slave to the adoration of any theory (though in England it goes perilously near to fiscal fetichism); it does not concern itself with a vain effort to attain logical perfection; it loves and boasts of its preference for the practical solution of difficulties by the application of common sense. To deal with this question there is only one common-sense method; that is, to meet together with an anxious desire to serve the Empire as a whole and a willingness to act in co-operation should a full consideration show the need for readjustment. There never was an occasion on which appeals to prejudice and party interests were more to be condemned; there never was a question which should more commend itself to both parties as one deserving a careful and sympathetic inquiry. Should such an inquiry be granted, those of us who believe that a readjustment of the commercial relations of the communities of the Empire will lead to a more lasting and more real union of that Empire are confident as to the result. We merely ask that we shall not be condemned without trial merely because our contentions may not exactly square with what was laid down fifty years ago for the guidance of commerce under conditions as primitive and simple in relation to the vast and complex system of to-day as is the first Atlantic steamer when compared with the most recent ocean liner.

A.—WAGES PAID IN MANUFACTORIES TO EMPLOYEES (MALES).

The figures are given as far as data is available.

Industry.	Average weekly wages.—Males. New South Wales.	Victoria.	Queensland (Brisbane).	New Zealand.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Boiling-down and tallow refineries	1 18 8	—	—	—
Tanneries	1 18 0	1 14 6	1 9 0	1 11 3
Wool-scouring and fellmongery	1 18 5	1 16 10	—	
Chaff-cutting	1 13 5	1 12 9	1 15 2	—
Oil and grease	2 0 9	—	—	—
Soap and candles	1 12 4	1 10 7	1 6 11	1 12 8
Bricks and tiles	2 6 3	2 4 6	1 18 11	1 9 0
Glass (including bottles)	1 12 5	1 11 4	—	—
Glass (ornamental)	1 18 5	1 14 10	—	—
Lime, plaster, and cement	2 0 6	1 16 0	—	1 14 9
Marble and slate	1 14 5	—	—	—
Pottery and earthenware	1 12 9	1 15 8	1 9 8	—
Boxes and cases	1 12 11	—	—	—
Cooperage	2 5 0	2 4 6	2 0 4	1 10 7
Joinery	2 3 10	2 3 0	—	—
Saw mills	1 15 7		1 13 3	1 9 0
Wood-turning	1 16 11	—	1 14 8	1 9 5
Agricultural implements	1 7 10	—	—	1 15 6
Brass and copper	1 9 8	1 9 8	1 9 4	
Galvanised iron	1 12 0	—	1 8 10	1 12 0
Ironworks and foundries	1 18 3	1 15 7	—	

TABLE A (*continued*).

Industry.	Average weekly wages.—Males. New South Wales.	Victoria.	Queensland (Brisbane).	New Zealand.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Engineering	1 14 9	—	1 16 0	1 13 0
Railway carriage works	1 13 4	—	—	—
Smelting	2 8 8	—	—	—
Stoves and ovens	1 12 3	1 12 8	17 8	1 13 9
Tinsmithing, sheet ironworks	1 6 2	1 7 7	1 3 7	1 6 5
Other metal works	1 19 4	—	—	1 10 4
Wire working	1 13 2	1 2 10	—	—
Bacon curing	2 2 3	1 18 6	—	1 8 11
Butter factories	1 14 1	1 14 9	—	1 11 6
Meat preserving	1 14 0	2 1 8	1 17 3	1 15 1
Biscuits	1 2 5	1 1 11	1 5 8	1 9 0
Confectionery	1 4 11	1 11 10	1 4 4	1 7 1
Cornflower, oatmeal, &c.	1 14 4	1 7 4	—	—
Flour mills	1 17 0	2 1 7	1 14 0	1 17 0
Jam and fruit canning	1 0 10	1 6 1	1 2 2	1 8 7
Pickles, sauces, and vinegar	1 7 3		1 5 4	1 3 1
Sugar refineries	2 0 6	1 15 3	—	—
Aerated waters, cordials, &c.	1 10 3	1 6 8	1 4 9	1 8 0
Breweries	1 16 1	1 17 10	1 10 3	2 7 5
Condiments, coffee, and spices	1 8 6	—	—	—
Distilleries	2 1 4	1 17 3	—	—
Ices and refrigerating	1 18 9	2 1 10	2 6 7	—
Malting	—	2 4 11	—	1 19 9
Tobacco, cigars, &c.	1 9 7	1 14 0	1 12 9	—
Woollen mills	1 3 7	1 3 6	—	1 15 9
Boots and shoes	1 12 9	1 15 1	1 7 6	1 13 4
Slop clothing	2 0 3	2 0 7	1 9 3	—
Clothing (tailoring)	2 4 5	—	1 18 2	1 15 0
Dressmaking and millinery	1 8 2	1 11 8	—	1 17 5
Hats and caps	1 15 3	1 19 2	1 2 5	1 7 5
Waterproof and oilskin	1 17 5	1 15 7	—	1 6 9
Shirts, ties, and scarves	1 14 9	1 14 3	1 0 0	1 6 3
Rope and cordage	1 3 7	1 4 2	—	1 6 4
Tents and tarpaulins	1 5 9	1 10 4	2 1 3	—
Paper bags, boxes, &c.	1 3 5	1 5 6	18 7	—
Printing and bookbinding	1 18 1	1 18 6	1 19 6	1 19 3
Musical instruments	1 17 11	1 13 5	2 3 0	—
Explosives	1 4 10	1 10 4	—	—
Coach and wagon building	1 10 11	1 10 7	1 13 5	1 7 1
Cycles	1 11 8	1 7 1	1 2 5	1 1 3
Ship and boat building	2 4 10	—	—	1 4 7
Iron bedsteads	1 9 4	1 15 1	—	—
Furniture and cabinet making	1 16 4	1 19 9	1 6 5	1 7 6
Picture frames	1 11 8	1 6 3	1 1 1	—
Chemicals, drugs, and medicines	1 10 10	1 7 0	1 5 2	—
Manufacturing jewellery	1 17 5	2 7 4	1 14 4	—
Electric light and power	2 2 10	1 19 0	1 11 2	—
Gasworks	2 4 9	—	—	2 7 8
Leather belting	1 14 10	1 9 9	—	—
Fancy leather, portmanteaux and bags	1 6 9	1 7 5	1 0 4	—
Brooms and brushware	1 11 7	1 13 4	1 0 5	1 6 8
Saddlery and harness	1 15 3	1 14 3	1 5 0	1 4 11
Basket and perambulator factories	1 6 8	1 15 4	—	1 3 5

B.—Wages paid in Manufactories to Employées (Females).

Industry.	Average Weekly Wages—Females.			
	New South Wales.	Victoria.	Queensland (Brisbane).	New Zealand.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Soap and candles	0 10 7	—	—	—
Meat preserving	0 12 2	—	—	0 16 3
Biscuits	0 13 2	0 12 2	0 8 1	0 11 2
Confectionery	0 9 3	0 13 4	0 7 4	0 8 2
Cornflour, oatmeal, &c.	0 12 9	0 12 2	—	0 9 5
Jam and fruit canning	0 12 3	0 13 10	0 10 3	0 8 3
Pickles, sauces, and vinegar	0 8 11		0 11 5	0 13 3
Aerated waters, cordials, &c.	0 17 3	0 15 0	0 11 5	—
Condiments, coffee, and spices	0 11 1	—	0 11 5	—
Tobacco, cigars, &c.	0 16 6	1 1 1	0 15 8	—
Woollen mills	0 12 11	0 17 8	—	0 16 11
Boots and shoes	0 12 3	0 14 0	0 12 10	0 13 3
Slop clothing	0 14 9	0 18 0	0 10 11	—
Clothing (tailoring)	1 1 8	—	0 13 10	0 15 11
Dressmaking and millinery	0 10 5	0 11 9	0 10 0	0 10 3
Hats and caps	0 13 4	0 15 0	0 14 0	0 13 3
Waterproof and oilskin	0 12 11	0 18 2	—	0 9 6
Shirts, ties, and scarves	0 12 1	0 14 10	0 11 1	0 10 5
Rope and cordage	0 11 0	0 11 8	—	—
Tents and tarpaulins	0 12 2	0 16 4	0 14 6	—
Paper bags, boxes, &c.	0 10 7	0 11 4	0 10 5	—
Printing and bookbinding	0 11 0	0 13 2	0 11 6	0 12 7
Bedding, flock, and upholstery	0 18 4	0 14 5	—	—
Chemicals, drugs, and medicines	0 10 10	0 15 8	0 11 4	—
Fancy leather, portmanteaus, and bags	0 12 4	0 12 4	0 8 9	—
Brooms and brushware	0 13 7	0 16 2	0 13 7	0 10 11
Saddlery and harness	0 16 2	0 15 9	0 10 0	0 17 2

C.—The Capital employed in Factories is distributed as follows:—

State.	Capital.			Total.
	Land, Buildings, &c.	Machinery and Plant.	Cash and Sundries.	
	£	£	£	£
New South Wales	4,969,698	7,009,806	7,417,000	19,396,504
Victoria	7,967,945	5,010,896	7,428,000	20,406,841
Queensland	2,631,039	4,052,584	1,858,000	8,541,623
South Australia	1,676,000	1,730,000	1,631,000	5,037,000
Western Australia	1,245,186	1,631,815	1,453,000	4,330,001
Tasmania	994,254	921,901	772,000	2,688,155
Commonwealth	19,484,122	20,357,002	20,559,000	60,400,124
New Zealand	4,690,877	3,962,521	4,556,000	13,209,398
Australasia	24,174,999	24,319,523	25,115,000	73,609,522

D.—The Distribution of Horse-power and Value of Plant is as follows:—

Class of Industry.	Commonwealth.		New Zealand.	
	Horse-power.	Value of Plant.	Horse-power.	Value of Plant.
	No.	£	No.	£
Testing raw material:—				
(a) The product of pastoral pursuits	5,331	418,125	1,519	91,423
(b) „ „ agricultural „	2,559	108,148	580	37,565
Oils and fats, &c.	1,801	474,866	428	44,203
Processes in stone, clay, grass, &c.	6,582	675,921	1,166	68,952
Working in wood	19,787	1,644,278	9,097	425,695
Metal works, machinery, &c.	20,659	3,333,555	2,780	317,072
Connected with food and drink, &c.	47,421	6,914,101	14,792	1,035,939
Clothing and textile fabrics, &c.	4,908	848,845	3,644	340,933
Books, paper, printing, &c.	4,827	1,769,294	1,762	381,958
Musical instruments	67	4,870	—	—
Arms and explosives	96	52,766	39	10,650
Vehicles, saddlery, and harness	745	171,829	226	38,868
Ship and boat-building, &c.	3,184	276,905	484	209,878
Furniture, bedding, and upholstery	1,158	113,132	464	28,249
Drugs, chemicals, and by-products	1,201	233,955	319	32,963
Surgical and other scientific instruments	11	4,043	—	—
Jewellery, plated ware, &c.	81	27,966	14	3,822
Heat, light, and power	37,931	3,205,496	2,419	871,653
Leatherware, not elsewhere included	135	12,093	—	670
Minor wares, not elsewhere included	838	66,814	206	22,028
Total	159,322	20,357,002	39,939	3,962,521

The horse-power quoted represents the average power actually used, and is exclusive of Electric Lighting Plants, while the value quoted represents that of all the available machinery fit for use.

E.—The Classes of Industry in which the Persons are Employed and the Horse-power used, as follows:—

Class of Industry.	1900.			1903.		
	Hands Employed.		H.P. of machinery used.	Hands Employed.		H.P. of machinery used.
	Males.	Females.		Males.	Females.	
Treating raw materials, the product of pastoral pursuits, &c.	7,276	27	6,271	7,432	44	7,890
Oils and fats, animal, vegetable, &c.	1,399	60	2,007	1,650	96	1,801
Processes in stone, clay, grass, &c.	7,308	41	4,820	7,859	85	6,582
Working in wood	16,413	15	18,505	16,232	30	19,787
Metal works, machinery, &c.	35,260	64	15,783	36,285	91	20,659
Connected with food and drink, &c.	30,281	4,353	48,113	26,755	4,555	47,421
Clothing and textile fabrics and materials	15,953	27,849	3,852	16,932	36,358	4,908
Books, paper, printing, and engraving	13,448	2,743	3,822	13,756	3,477	4,827
Musical instruments	141	10	24	239	15	67
Arms and explosives	176	77	137	135	226	96
Vehicles and fittings, saddlery and harness, &c.	7,692	86	562	7,457	69	745
Ship and boatbuilding, &c.	2,117	45	1,186	1,965	14	3,184
Furniture, bedding, and upholstery	4,136	378	856	5,012	428	1,158
Drugs, chemicals, and by-products	961	245	660	1,509	492	1,201
Surgical and other scientific instruments	70	15	13	98	19	11
Jewellery, time-pieces, and plated ware	786	22	89	1,076	45	81
Heat, light, and power	2,668	94	13,789	3,575	91	37,931
Leatherware, not elsewhere included	279	35	51	384	68	135
Minor wares, not elsewhere included	1,288	349	363	1,314	556	838
Total	147,652	36,508	120,903	149,665	46,759	159.322

F.—THE DISTRIBUTION OF THE INDUSTRIES THROUGHOUT THE COMMONWEALTH IS AS FOLLOWS:—

Class of Industry.	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.
Treating raw materials, the product of pastoral pursuits	2,499	1,937	501	468	70	117
Treating raw materials, the product of agricultural pursuits, &c.	288	1,039	25	329	37	166
Oils and fats, animal, vegetable, &c.	625	528	165	293	67	68
Processes in stone, clay, glass, &c.	3,073	3,076	422	497	679	197
Working in wood	5,167	3,713	2,272	424	3,584	1,102
Metal works, machinery, &c.	12,851	10,350	3,215	6,090	2,107	1,763
Connected with food and drink, &c.	10 469	10,602	4,926	2,484	1,335	1,494
Clothing and textile fabrics and materials	15,486	26,136	3,785	4,659	1,686	1,538
Books, paper, printing, and engraving	6,135	6,525	1,935	1,166	962	510
Musical instruments	219	25	1	9	—	—
Arms and explosives	19	342	—	—	—	—
Vehicles and fittings, saddlery and harness, &c.	2,102	2,973	844	815	509	283
Ship and boat building, &c.	1,501	98	139	111	92	38
Furniture, bedding, and upholstery	1,923	1,978	465	563	302	209
Drugs, chemicals, and by-products	693	987	34	230	57	—
Surgical and other scientific instruments	64	35	18	—	—	—
Jewellery, timepieces, and plated ware	257	594	53	133	41	43
Heat, light, and power	1,672	988	367	184	313	142
Leatherware, not elsewhere included	133	283	27	—	—	9
Minor wares, not elsewhere included	457	1,020	92	189	42	70
Total	65,633	73,229	19,286	18,644	11,883	7,749

G.—THE EMPLOYMENT IN THE COMMONWEALTH AND IN NEW ZEALAND IS RESPECTIVELY AS FOLLOWS:—

Class of Industry.	Commonwealth.		New Zealand.		Australasia.	
	Males.	Females.	Males.	Females.	Males.	Females.
Treating raw materials, the product of pastoral pursuits	5,570	22	2,286	1	7,856	23
Treating raw materials, the product of agricultural pursuits, &c.	1,862	22	216	10	2,078	32
Oils and fats, animal, vegetable, &c.	1,650	96	240	26	1,890	122
Processes in stone, glass, clay, &c.	7,859	85	1,273	2	9,132	87
Working in wood	16,232	30	6,635	2	22,867	32
Metal works, machinery, &c.	36,285	91	6,259	5	42,544	96
Connected with food and drink, &c.	26,755	4,555	7,069	628	33,824	5,183
Clothing and textile fabrics and materials	16,932	36,358	7,687	9,579	24,619	45,937
Books, paper, printing, and engraving	13,756	3,477	2,799	754	16,555	4,231
Musical instruments	239	15	23	—	262	15
Arms and explosives	135	226	21	111	156	337
Vehicles and fittings, saddlery and harness, etc.	7,457	69	2,636	55	10,093	124
Ship and boat-building, &c.	1,965	14	185	—	2,150	14
Furniture, bedding, and upholstery	5,012	428	1,887	76	6,899	504
Drugs, chemicals, and by-products	1,509	492	291	58	1,800	550
Surgical and other scientific instruments	98	19	14	2	112	21
Jewellery, timepieces, and plated-ware	1,076	45	72	3	1,148	48
Heat, light, and power	3,575	91	763	166	4,338	257
Leatherware, not elsewhere included	384	68	43	20	427	88
Minor wares, not elsewhere included	1,314	556	623	108	1,937	664
Total	149,665	46,759	41,022	11,606	190,687	58,365

DISCUSSION.

The CHAIRMAN was sure that all had listened with very great pleasure to the paper. The author had the pen of a ready writer, but he had still more markedly the tongue of an eloquent speaker. He had properly laid stress on the enormous difficulties due to distance which Australia had to combat. The public of this country, however, were very much better informed on that subject than they used to be. They all knew the story of a young bishop who contemplated going out to Perth, and who, not being very experienced in the wielding of the crook, was told by a friend that there was a most experienced prelate in Adelaide, and if he had any difficulty, all he had to do was just to step across and consult him. There was also the story of the Commandant in Tasmania who received orders to march his regiment by easy stages to Sydney. But the geography of the Empire was better understood now on both sides. The author spoke perfectly truthfully when he said that Australian manufactures were still in their infancy. He also thought that the idea of Australians remaining merely primary producers had disappeared. They did not want the British Empire to be composed of sections of nations scattered in various quarters of the globe. That Imperial federation to which they looked forward would be impossible if the colonies which had sprung from the Mother Country were not equipped and furnished with all necessities for full national life. The author had pointed out that per head the Commonwealth produced more from primary industries than any other country, the figures being £21 12s. 9d. in Australia, as compared with £7 18s. 6d. in this country. Doubtless they remembered the saying in a British colony where the only industries were those of canning and preserving their natural produce, "Eat what you can, and can what you can't," but they wanted the industries of Australia and of every portion of the British Empire to extend far beyond those of elementary production. He thought the author was on sound lines when he claimed that the Federation of Australia had presented a magnificent opportunity for the advancing of Australian manufactures. Why was that the case? It was simply because the Federation of Australia was the consummation of a great free trade movement by the adoption of a tariff. Under the Federation the Custom-houses on the various borders were abolished, and every manufacturer had the advantage of the market of adjoining States. How was this free trade within the continent of Australia achieved? The pathway to free trade lay through the territory of protection. It was when the other States followed the example of Victoria and erected fiscal barriers on their borders that the cry arose for the abolition of those barriers; if all the States had been content to see Victoria continue her protectionist policy whilst they themselves admitted her goods free, there would not have been free trade throughout Australia at the present time. They all desired free trade, and if free trade would not come to them, they would have to go to free trade; and even though it was necessary to approach that ideal through tariff reform that was no reason why they should not advance in the pursuit of it. The author had alluded to the Australian workman. He (the Chairman) had himself come to the conclusion, after seeing labour in many parts of the world, that there was no labour so cheap, taking into consideration efficiency, as that of the Australian worker. He was alert, bright, and active, and in advancing the manufactures of Australia there was most excellent material provided, not only by nature but also in the shape of willing, capable, and efficient labourers. The manufactures of Greater Britain were not built up by orthodox methods; in Canada the heretics carried the day, and the same remark applied to Australia. It would surprise those who still adhered to the methods of the old school to know to what extent bounties and State-aid had ministered to the development of Canadian and Australian industries. As a matter of fact, the origin of manufactures in both those countries dated back practically to the departure from the shibboleths of the *laissez-faire* school. They were on the search for knowledge in Australia, and, having what might be called a well-balanced prejudicial mind on the question of tariffs, they would like to hear of any great industry that was rooted in free trade. He knew of none. The tariff of Australia was very limited as compared with other countries, and he would say to the manufacturers of Great Britain that now was the accepted time to join reciprocal hands with Australia, as the opportunity might not occur again so favourably when the tariff walls were built up higher.

MR. C. C. LANCE (Commercial Agent for the Government of New South Wales) said the author had displayed great ability in dealing with the subject, but he would like to make mention of one small matter in regard to the frozen meat trade. He said it was inaugurated by New Zealand in 1882, whereas the first ship that brought frozen meat across the world was the *Strathleven*, which was loaded in Sydney and Melbourne in 1880. But that fact did not at all detract from the credit due to New Zealand for the way in which it had developed its frozen meat trade. The Chairman had mentioned the question of bounties in developing industries, and it occurred to him to mention of what great value bounties had been to the butter industry. The butter bounty originated in Victoria, bonuses being given for the erection of factories and for all butter sent to this country that realised a certain price. The bonus amounted to 3d. per lb. in the first instance, but had gradually been discontinued. Factories arose everywhere throughout the country, and in the course of two or three years a great industry was built up, which, without bounties, would have taken much longer to develop.

Sir M. M. BHOWNAGGREE, K.C.I.E., M.P., joined with the Chairman in the very deserved commendation passed upon the paper and its author, and heartily congratulated Australasia upon the exceedingly prosperous condition of affairs with regard to its industries. A comparative table was given in the paper with regard to the temperance of the Australian people as compared with the people of other civilised nations, and, if the figures referred only to the white population, he thought that formed an additional subject for congratulation. With regard to wages, if the rate was higher in Australia than America, and living cheaper in Australia than America, then the condition of the Australian working man was very flourishing indeed. But if the condition of the Australian working man was so extraordinarily flourishing, why did he want to keep out labour from other parts of the Empire? If any body of working men from the Empire of India wished to enter Australia a great number of difficulties were thrown in their way. He granted that when bands of emigrants had gone out from the Mother Country in search of a mere sustenance and the necessaries of life, they had a prime right to keep for themselves the colony which their labour and sacrifices had established; but what he complained of was that form of competition and prejudice which kept out the British Lascar. He did not think it conducive to the further cementing together of the British Empire for Australia to refuse, against the advice of such an Imperial statesman as Mr. Chamberlain, to enter into a postal contract in order that its shores might not be "polluted" by any ships upon which Lascar seamen were employed. He spoke in the presence of influential colonists and of his esteemed friend, Sir John Cockburn, than whom he did not know a better Imperialist and friend of the Empire, and he asked if it was not time, when at meetings like the present they were talking so much about the unity of the British Empire, that these gentlemen should denounce restrictions that were creating irritation among 300 millions of people. He did not think he would be doing his duty as a citizen of Imperial Britain if, when he happened to be present in a room where the subject of Imperial unity was being discussed, he did not point out that great defect which had been made manifest in many ways in the policy of the Australian Commonwealth.

Mr. H. ALLERDALE GRAINGER (Agent-General for South Australia) thought the views which the last speaker had expressed would commend themselves to any body of Australians. But they had found out that people, whether they came from India or China or elsewhere, were apt to cut out the Australian workman by working longer hours for less wages. Australians were not all of one mind on the subject of the refusal to make mail contracts with steamers employing black labour. They were not allowed to enter into such a contract by an Act carried in the Federal Parliament with the support of Sir Edmund Barton, Mr. Reid, and others. He thought it was a very foolish thing indeed, but the majority had it their own way. With regard to the author's reference to the exports and imports, he thought it was misleading to talk about the imports in Australia being so much less, without reference being made to the fact that Australia was unable to borrow money on good terms in England. When they did begin to extend their railways, the imports would mount up by the million. When anybody referred to the figures of exports and imports they ought to go very carefully into the details, and point out where the falling off in those imports had been. He was a Protectionist himself, but he admitted that the Free Traders had strong arguments on their side; in fact, he went a great deal further than some of them so far as Australia was concerned. Australia had to look after its own commercial interests to the best of its ability. One did not give trade to one's relations if they charged more than anybody else, and if Australia by entering into an agreement with other nations could make money over it, he would vote in favour of that policy, whether he was considered patriotic or otherwise.

Mr. JAMES, in reply, said he was at a loss to understand why any suggestion which involved commercial co-operation, such as preferential trade, should necessarily imply either political or social co operation. He did not think the question to which reference had been made by Sir M. Bhownaggree was relevant to the subject. It was a very important question, and too long and contentious to discuss now, but he assured his hearers that it was an entire misconception to say that legislation in that respect was based upon any selfish desire to protect the Australian working man from competition; it was founded on deeper and broader convictions than that. He wanted to dissociate himself entirely from Mr. Grainger in reference to the mail service; it had nothing whatever to do with discussing the question of Australian manufactures, and he regretted the question had cropped up. Mr. Grainger had also said that he should have examined his figures in greater detail. The last words in the paper were words of apology for the time he had taken up, and he asked the audience whether they would have approved of his taking up additional time in the closer analysis of the figures of one year's returns. No one could deal with the question in a short paper. Figures, of course, could be made to prove anything, but the fact remained that the output of manufactures was increasing, and anyone could see in Australia many evidences of the increased development of Australian manufactures.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. James for his valuable paper.

COMPENSATION FOR INJURIES TO WORKMEN.

There has just been issued a memorandum on the laws of foreign countries and of British possessions relating to the rights of workmen to compensation for injuries by accidents occurring in the course of their occupation. This memorandum has been drawn up by Sir Kenelm Digby, as Chairman of the Committee on Foreign and Colonial Laws relating to Compensation for Injuries to Workmen. It is hoped that on another occasion space will allow of a more extended reference to this very valuable State paper, but in this issue of the *Journal* note is taken of the law as it stands in the only great country which has not as yet in any form adopted the principle of workmen's compensation for accident without proof of any default, namely, the United States. In all the principal European countries the laws relating to the subject seem to have passed through similar stages. In the earlier part of the nineteenth century the workman had no special claim to redress from his employer for injury from accident. His right was the same, neither more nor less, as that of anyone else who had the right to claim compensation from a person responsible for causing an injury, that is to say, the workman, in order to recover damages for an injury, had to prove a default on the part of the employer himself, or of some person for whom he was responsible. But the vast advance made during the past century in the magnitude and complication of industrial enterprises, the establishment and extension of railways and of machinery moved by steam power, and the increase in the number of industrial accidents with which the advance was attended, induced every European Government to review its laws providing compensation for injuries by accident, with the object of improving the position of the workman and enabling him to obtain more adequate redress. It is only in the United States that the workman remains where he was in the matter of compensation for injuries by accidents occurring in the course of his employment.

The law varies to a considerable extent in different States of the Union, but in all it is grounded on the English Common Law. The doctrine, however, of "common employment" does not appear to be, says Sir Kenelm Digby, recognised to the same extent as in England. Nor is the view taken of the extent of the doctrine uniform throughout the various States. "While the general law is stated to be that the workman takes upon himself all risks resulting from the negligence of his fellow servants, this rule does not apply to the agents of the employer to whom he has delegated his own authority, and there have been wide differences in the various States as to the persons who are and who are not to be regarded as fellow servants. Several States have adopted modifications of the Common Law in the direction of increasing the liability of the employer for the negligence of a fellow servant, chiefly in the case of employment on railways, and some have passed laws extending similar principles to other industries. But no State has gone the length of enacting any law imposing upon the employer any duty to contribute to the relief of workmen from the consequences of accidents not proved to have been caused by the default of the employer himself, or of some person for whom he is responsible." In this state of things it is surprising to find that the rates of assurance against employers' liability are, in the experience of the leading English companies doing business in America, "Very much higher than the rates for liability in this country, both under the Employers' Liability Act of 1880 and the Workmen's Compensation Act of 1897." The explanation is to be found in the heavy verdicts which American juries give in the cases which in fact are brought into the courts.

In 1903 the Governor of Massachusetts appointed a committee to report on the relations of employer and employee, and in their report, dated January, 1904, the committee dealt with the question of workmen's compensation. They referred to the Bills bearing on the question, no less than three of which had been introduced into the last State Legislature, and reviewed the State law as to remedies for industrial accidents. The committee dwelt on the dissatisfaction felt with the existing state of the law—both by employers and employed—the employers complaining of the growing burdens of litigation and of the tendency of juries "to increase their burdens by awarding liberal verdicts against them." The workmen complained that under existing conditions injured employees did not receive "a fair and certain compensation for their injuries." They complained also of the delays in the courts; that they were forced to fight "not their employers but unsympathetic employers' liability insurance companies, with their corps of claim agents, experts, and attorneys." "It is further claimed that the injured employee, if after a long time he is successful in recovering damages, receives in the end but a small part of the sum so recovered, owing to the expenses of litigation, and the exorbitant and unreasonable charges of his lawyer and medical adviser." To remedy this state of things the committee drafted a Bill closely following the English Compensation Act of 1897—even adopting some of its proved defects—with, however, some important variations. The most important of these is that the proposed interval between the accident and the commencement of the compensation shall be one week and not two. A more effective obligation to elect between the remedies open to the workman is provided, and a careful provision is made, somewhat differing from our law, as to the vexed question of "sub-contracting," and "workshops" are included as well as factories. A measure based upon the Report of the Committee was introduced into the Massachusetts Legislature last year, but not carried. It has been again introduced in the present Session, but has still to become law. As yet no American State has passed an Act of the kind.

THE TECHNICAL SIDE OF EDUCATION IN THE WEST INDIES.

There has recently been issued by the Board of Education volume 12 of the "Special Reports on Educational Subjects" (Cd. 2377),* which deals with the educational systems in the West Indies, Central America, St. Helena, and Gibraltar. The history of education in each colony or possession is given, together with a description of the present state of education, and copies of various legislative enactments and syllabuses of study. Generally speaking, doubts may be entertained as to whether the type of education afforded is that best suited for the needs of the case. For instance, in the Bahamas, where special attention is given to the teaching of sewing to girls, it is stated that "none of the boys reached by the Education Act proceed with their studies after leaving school." The demand for clerks in the Government service or in stores is extremely limited and poorly remunerated, while there is a dearth of artizans. "At present there is not one master carpenter, blacksmith, or mason in the colony, and no means of training these." A system based upon the industrial training methods in Tuskegee, in Alabama is, therefore, advocated. Barbados and Bermuda also possess no technical or industrial schools. In British Honduras, commercial instruction is given at one of the colleges, and the establishment of a botanical station for the purpose of affording practical information to persons interested in agriculture is contemplated. In Trinidad agriculture has been added to the subjects of instruction in the elementary schools, and school gardens are becoming the general rule. A committee has also been appointed to consider the question of systematic technical education. In Grenada no manual training or instruction in handicraft is provided. Sewing and domestic economy is taught in the elementary schools, while the teaching of agriculture is provided for pupils in the higher standards. The teaching of this subject is rather hampered by the lack of suitable plots. St. Lucia possesses an agricultural school, conducted on an abandoned sugar estate. In addition to the providing of a general education, the chief aim of the school is to train "practical agriculturalists in the full sense of the words, not only by teaching them to handle hoe and cutlass, and by putting them to such manual labour as their strength allows, but also by giving them all the necessary instructions in the sciences allied with agriculture." St. Vincent possesses a similar school.

One of the most readable parts of this publication is an appendix written by the Bishop of Jamaica on education in that island in relation to skilled handicraft and agricultural work. It is certainly surprising to read that in this respect the present position in the island is actually inferior to that in vogue during the slavery days, when "there was on the estates practically a universal system for training a regular succession of masons, carpenters, blacksmiths, coopers, and workers in similar trades. Frequently artizans were brought out from England to become the head men in these departments, and in other instances native workmen were quite competent to instruct those put under them, and so hand on to the next generation the secrets of their trades." A diminution in the numbers of skilled artisans has, therefore, taken place, as has also occurred in the southern States of the Union. As regards agriculture, the negro population of Jamaica may be considered expert in the cultivation of the sugar-cane, coffee, yams, cocoa, sweet potatoes, and the like, except in so far as modern scientific knowledge requires to be applied to these cultivations. "But as regards the numerous other products that need to be cultivated in the place of the doubtful and failing industries, the black people have everything to learn."

The following represents the course of tuition in agriculture as now afforded in the various schools. In the elementary schools there are three divisions for this subject. In the lower division a course of thirty-six lessons is given in animal and plant life, dwelling especially on the animals and plants found in Jamaica. In the middle and upper divisions more advanced general science is taught, and also more agricultural science, including the formation of soils, plant food, manures, and common objects of cultivation in Jamaica. An advanced course is also provided in certain schools. This is a practical application in out-door experiments of the knowledge obtained in the schools. An experiment ground of not less than a quarter of an acre must be provided in which every boy above eleven years of age must be taught practical skill in all agricultural operations. The extensive introduction of the advanced course is at present restricted on account of a lack of properly trained teachers. These latter undergo a special three years' course of preparation at the Mico College. Detailed information on this matter, as well as a review of the special schools now in existence in Jamaica, will be found in the appendix, which at once affords a clear statement of present facilities for, and a sympathetic treatment of, the problems of the mental, manual, and moral uplifting of the negro race in the West Indies.

* Published by G. Wyman and Sons, Ltd., Fetter-lane, E.C. Price 2s.

AUSTRALIAN TOBACCO.*

A considerable portion of the Australian Commonwealth, an area of at least several thousand acres is, like many of the lands in the American southern States, admirably adapted for tobacco cultivation, although the industry, after years of experimental labour, is yet in its infancy, Americans visiting Australia expressing surprise at the limited attention it

* Communicated by Mr. John Plummer, Sydney, New South Wales.

has received in many places. In New South Wales, we are told, the systematic cultivation of tobacco dates from 1874, in which year it was introduced by three Chinese settlers, who produced within a few months a sufficiency of cured leaf to bring them £180, the Sydney selling price being 6d. per pound. Four years later the prices rose to 8d. and 9d. per pound. In 1880 the area under cultivation in the Tumut district was 1,400 acres, on which 400 Chinese were employed. Two years later the price dropped to 5½d. per pound than to 5d., and, finally to 4½d., at which it did not pay the growers. Recently the rise of keen competition in the Australian tobacco manufacture has occasioned a demand for locally-grown leaf. The State Government has fully recognised the importance of encouraging the tobacco-growing industry by establishing a couple of plantations, in which the practicability of obtaining a first-class article has been clearly shown. Yet, notwithstanding this encouraging result, the area under cultivation in the State during 1903-4 was only 407 acres, the production being 5,220 cwt. of leaf. In 1888, 4,883 acres were under cultivation, producing 55,478 cwt. of leaf, but there was no over-sea market for it, and growers became discouraged. It was much the same in Victoria, where the area under tobacco in 1903 was 129 acres, against 2,029 acres in 1905, and in Queensland, where the area in the same year was 772 acres, against 1,061 acres in 1895. The cause of this decline is readily explained. The leaf had not, save by way of experiment, been prepared in such a manner as to find a sale in over-sea markets. Much of the curing has been done in a somewhat primitive fashion, Australian farmers too frequently imitating the crude methods of the Chinese growers, who aim at quantity rather than quality. What can be done in the right direction is shown by the fact that, at the close of 1903, a number of test samples of manufactured tobacco, from leaf grown at the Victorian State tobacco farm at Edi, were prepared by the manager of an Australian tobacco company, who expressed himself pleased with them generally. The cigar varieties of leaf were handed over to another tobacco manufacturing company, the manager of which, reporting to the Victorian Minister for Agriculture, spoke favourably of them, that they were the best samples of Australian-grown cigar leaf ever submitted to him. All the leading importers in Melbourne spoke favourably of the samples submitted, and it was fully demonstrated that if due attention be given to the details of cultivation and curing, tobacco can be as successfully grown as any other agricultural crop in the Commonwealth. In Queensland the tobacco-growing area is somewhat extensive, the cultivated portions being found chiefly in the southern part of the State, west of the Great Dividing Range. Tobacco has been successfully grown as far north as the Herbert River, also in the Mackay and Cairns districts; and it is believed that in the near future tobacco cultivation, notwithstanding fluctuations in production occasioned by unfavourable climatic and other conditions, will become one of the staple industries of the State. The Queensland Secretary for Agriculture, in his annual report for 1902-3, says, that the possibility of a successful growth of the tobacco plant has never been in dispute, nor has the cultivation of it passed the ability of the farmer who understands his work. The sole difficulty has been the imperfect curing of the leaf. At the State tobacco farm at Texas a couple of tons of tobacco were raised, notwithstanding the absence of rain, which, when cured, realised 11d. per lb. at public auction, the highest price yet obtained in Queensland under similar conditions. Small quantities of tobacco are grown in South Australia and Western Australia, where there are extensive tracts suitable for the purpose, but at present remaining unutilised. In fact, it is believed that the Australian area capable of producing commercially valuable tobacco is larger than that found in the American southern States. The quantity of unmanufactured tobacco imported into the Commonwealth during 1903 was 5,156,793 lbs., value £232,884, of which 4,998,969 lbs., value £224,961, came from the United States. If Australian tobacco growers could supply sufficiently large supplies of leaf equal to that imported, they would readily become absorbed in the local market. What is required is experience and capital. With these combined, tobacco cultivation would speedily become a highly-remunerative Australian industry.

SPIDER-SPUN SILK.

A good deal of interest has been aroused as to the practical uses to which the webs of a large Madagascar spider might be applied to replace silk for woven fabrics, and the United States Consul at Tamatave calls attention to webs which he has noticed in his visits to the interior, spun many feet across the walks or shady avenues of gardens, which are sufficiently strong to bear the weight of a light bamboo walking-cane. At the Paris Exposition of 1900, a whole piece of fabric, 18 yards long and 18 inches wide, was exhibited, which was woven out of this web, for which it was necessary to provide 100,000 yards of spun thread of 24 strands. For its manufacture 25,000 spiders had to be brought into requisition, and these were procured by offering the natives so much a hundred; but, not knowing or ignoring the purposes for which the insects were required, they brought them in by the basketful, mostly dead. So it was found necessary for the winding-off machines to go to the spiders, instead of calling in the spiders to the winders. However, the piece of cloth was completed, and was of a golden yellow colour. The idea of obtaining silk from the spider is an old one, as the subject was discussed in France as long ago as 1710, but the study of this Madagascar spider came more particularly under notice some seven or eight years ago,

and the spinning of its web was then undertaken. It is only the female that spins. The first difficulty in securing the thread direct from the insect consisted in contriving how to secure the living spider so as to wind off, by some mechanical process, from the insect. This was originally performed by confining the spiders in empty match-boxes with the abdomen protruding, which could be compared to so many reels, from which the threads is wound off. The extraction of the web does not, apparently, inconvenience the insects, although care has to be taken not to injure them. From that stage was derived a frame of twenty-four small guillotines, in each of which a spider is secured in such a manner that on on one side protrudes the abdomen, while on the other head, thorax, and legs are free. This precaution of keeping the legs out of the way is necessary, because the spiders, when their secretions are spun off in this fashion, are liable to break off the web with their legs. It appears in the opinion of many to be an established fact that the Madagascar spider's web is capable of being woven into cloth which might warrant its cultivation for purposes of textile industry. The idea of using cobwebs as a hemostatic was known to the Greeks and Romans, and before the present antiseptics were brought into use by medical science, they were in general use for stopping the flow of blood from wounds and cuts. From an industrial point of view, the silk of the spinning spider has, it is said, been known for centuries, even by the savages of Paraguay, and in the seventeenth century Alcide d'Orbigny ordered in South America a garment of this material. There is in existence in Venezuela a spinning spider, found in the palm-trees there, some of which produce white and others yellow silk. The entomologist of the United States Department of Agriculture has reported that silk produced in this way cannot be made valuable commercially because of the troublesome necessity of keeping the spiders separated to prevent their devouring each other. The entomologist added that attempts to utilise the silk of a Madagascar spider of the same species as the Venezuelan variety resulted some years ago in the discovery that the product was more expensive than ordinary silk. The Madagascar spider is the *Nephila Madagascariensis*, and combines all the characteristics of Arachnida in general. Its bite is not dangerous, although the irritation caused by its legs is annoying. The egg which produces the spider is laid by the female is a silky cocoon one inch in diameter, of a yellow colour at first, but turning white after an exposure of two or three months to the air, at the end of which time several hundred insects, the size of a pin-head, burst the shell and come out. Three months later the female is two and a half inches long, while the male remains only one-sixth of that size. The spiders are carnivorous, and by preference frequent the forests. In some of the wooded gardens in the suburbs of the capital of Madagascar, especially the old royal parks, they may be seen in millions, and would give the impression of being gregarious, but this is not so, it being the abundance of food which brings them together in seeming peace and amity, but as soon as the supply fails, they fight and devour each other. In the early attempts to rear them, two hundred were placed in a wire cloth case; they spun their webs over the walls of their prison until it was so completely covered, that no mosquitos or other insects could get in. Thus deprived of food, on the principle of the survival of the fittest, the stronger went on devouring the weaker until only a few were taken out alive, but these had attained an enormous size. This spider is little disposed to migrate from its abode, and submits without resistance to manipulation. The first experiments in Madagascar were due to a Catholic missionary, and his experience proved that after the laying period, or formation of the web, it can be reeled off five or six times in the course of a month, after which the spider dies, having yielded about 4,000 yards. Native girls do the work. Each one has a straw basket at her side every morning filled with live spiders, and another basket to receive them after they have been wound off. One dozen are locked in at a time, the ends of their webs are drawn out, collected into one thread which is passed over a metal hook, and the reel is set in motion by a pedal So soon as the insect gives out no more web, it is replaced without stopping the wheel, and, later on, carried back to the park, where it requires nine or ten days before being ready for a second operation. The cost of this silk web is high; 55,000 yards of 19 strands in thickness weigh only 386 grains, which, calculating the time and labour of procuring and preparing it, brought it up to £8 per pound.

GENERAL NOTES.

Coal Industry of the United States.—Mr. E. Seymour Bell's report on the coal industry of the United States (No. 631, Miscellaneous Series) shows that the total production of coal in the United States in 1903 was the largest on record. It amounted to 319,068,228 tons, valued at 503,724,381 dols., and exceeded that of 1902 by 50,000,000 tons. The prices, too, for both anthracite and bituminous coal, reached the highest point recorded in a period of 24 years, the average of the one being 2·28 dols. per ton, and of the other 1·39 dols. Anthracite coal is produced almost exclusively in the State of Pennsylvania, only small quantities, not amounting to 100,000 tons per annum, being found in Colorado and New Mexico. Bituminous coal is found in almost every State of the Union, and extends over an area of 300,000 square miles. Of the coal exported from the United States in 1903, no less than 79 per

cent. went to the Dominion, and of the rest 10 per cent. went to Mexico and 8 to the West Indies. The output of coal in Pennsylvania is increasing with great rapidity. Anthracite has risen from 23,437,500 tons in 1876-80 to 54,598,908 tons in 1901-3 (3 years); bituminous in the same period from 31,830,357 tons to no less than 228,807,839 tons. Taking the average prices of the year, they were highest in Idaho—3·47 dols. per ton—California being next with 3·20 dols. The lowest was 1·08 dols. in Virginia, the next being 1·19 dols. in Kentucky.

TECHNICAL EDUCATION IN BURMA.—In connection with the Engineering School at Indis, it is proposed that the present qualification for joining which consists in passing an entrance examination, should be replaced by a probationary period of six months devoted to technical training. It is anticipated that this change will improve the status of those who pass from this school into the subordinate grades of the Public Works Department. Ultimately, if a sufficient number of students offer themselves, it is proposed to raise the status and curriculum at Insein to that of the engineering colleges of Roorkee and Sibpore.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MAY 3.—"Recent Excavations in Rome." By MRS. BURTON-BROWN.

MAY 10.—The Native Races of the Unknown Heart of Central Africa." By LORD VISCOUNT MOUNTMORRES.

MAY 17.—"The Use of Wood Pulp for Paper Making." By S. CHARLES PHILLIPS, M.S.C.I.

MAY 24.—"Modern Lightning Conductors." By KILLINGWORTH HEDGES, M.Inst.C.E., Hon. Sec. to the Lightning Research Committee.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A.

MAY 18.—"Plague in India." By CHARLES CREIGHTON, M.D.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MAY 2, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

LECTURE I.—MAY 1.—Application of the term embroidery to methods of working ornamentally with threads—Specimen of Egyptian embroidery, 1450 B.C.—Correspondence of its method with that of much Greek and Roman embroidery—Embroidery as an occupation in Greek houses, and as a trade in Rome—Embroidery in Benedictine monasteries and convents—The relation of illuminations in MSS. to designs for embroideries—The Dalmatic of Charlemagne, and suggestions of its figure designs being derived from Frankish illuminations of the 9th century—Comparison of designs for Bayeux tapestry, with outline figure drawings in MS. of Ælfric's Pentateuch.

LECTURE II.—MAY 8.—Embroidery in England, 12th and 13th centuries—MS. illumination, painting and embroidery as secular arts in 13th and 14th centuries—Influence of work in one art craft (the Goldsmiths') on that in another (Embroiderers')—Types of ecclesiastical English embroidery 13th, 14th, and 15th centuries, compared with contemporary illuminations in MSS. — Designs for English embroidery gradually affected by developments in ornamental weaving abroad—Symmetrical and floral patterns taking the place of designs with figure subjects having an epical or story-telling interest—English secular embroidery of the 16th and 17th centuries — The "conceits" in embroidery of the Elizabethan and Stuart periods—Embroidery in costume in 16th, 17th, and 18th centuries—Aspects of modern English embroidery—the designs for it: different phases of its practice, for ordinary trading purposes, for more limited purposes, and for specia occasions in connection with technical instruction—Embroidery.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

LECTURE I.—MAY 15.—*Application of Electricity and Character of Load.* — Winding—Haulage—Pumping—Coal cutting—Other uses underground—Surface requirements—Generating stations—Cables and distribution — Lighting — Signals — Telephones—Shot firing.

LECTURE II.—MAY 22.—Alternating and direct currents — Precautions — Enclosed motors — Home Office rules—Costs—Typical and historical plants described.

The lectures will be illustrated by lantern slides.

MEETING ON THURSDAY, APRIL 27...Electrical Engineers, Great George-street, Westminster, 8 p.m. Discussion of Mr. B. J. Arnold's Address to the Joint Meeting at St. Louis "On the Problem of the Alternate Current Motor applied to Traction," and Mr. F. Creedy's paper, "The Alternate-Current Series Motor."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 1, 8 p.m. (Cantor Lectures.) ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." (Lecture I.)

TUESDAY, MAY 2, 4.30 p.m. (Applied Art Section.) J. STARKIE GARDNER, F.S.A., "The Monumental Treatment of Bronze."

WEDNESDAY, MAY 3, 8 p.m. (Ordinary Meeting.) MRS. BURTON-BROWN, "Recent Excavations in Rome."

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, April 6th; THE MOST HON. THE MARQUIS OF BATH in the chair.

The CHAIRMAN was sure Sir George Scott required no introduction to the present audience; they were all well acquainted with his distinguished career, and no one was better qualified than he was to deal with the subject of his paper. Before calling upon the author to read his paper, he ventured to suggest that they could not pass over in silence the terrible calamity which had just overtaken India. It was, to his mind, an overwhelming disaster, and he felt that they ought to express their deep sympathy with those who had suffered in the terrible earthquake.

The paper read was—

THE PROSPECTS OF THE SHAN STATES.

BY SIR J. GEORGE SCOTT, K.C.I.E.

The Shan States form the most easterly part of Burma, which is the easternmost province of our Empire in India. Beyond the borders of our States lie the territories of China, French Indo-China, and the kingdom of Siam. There was a time when four empires met at Alanlegyet, the "Hill of the Four Standards," but we did not urge our claims to the limit. The Mèkhong river is the common meeting-space of the four countries, but they nowhere all touch at one point. On a map of Asia, however, the distance may be disregarded.

In most parts the populations beyond the frontier are also of the Shan and Tai race—Chinese Shans, French Shans, and Siamese Shans. It has, however, to be noted, that although the Shans are always looked upon as a hill race, they themselves consider that they are nothing of the sort, and, as a matter of fact, they are in the vast majority dalesmen, or dwellers in the wide straths, which many hundred years ago were lakes. Formidable hill ranges mark the frontier line in most places, and these are occupied by a great variety of hill tribes, many of them of an entirely different family from the Tai, such as the sanctimonious Rumai or Palaungs, or the head-hunting Wa, who belong to the Môn-Hkmêr subfamily; and the Lahu and Akha, who may or may not be Tibeto-Burmans, as is suggested, on the strength of a few vocabularies, by the learned editor of "The Linguistic Survey of India." Others who have studied the races in their hills are inclined to hint tentatively that at any rate the Akha may be Môn-Hkmêr, or may even represent the races of the Lemurian continent, now beneath the waves of the Indian Ocean. But beyond these ranges, the valley-dwellers north, east, and south are Tai. All the rivers, great and small, run southwards, separated by huge parallel ranges starting from the eastern Himalayas and all falling away to the south. One of them, the eastern watershed of the Salween river, far outrivals the others, and forms the backbone of the Malay Peninsula.

It is this breaking up of the country into long, narrow valleys or big oval straths, or here and there west of the Salween, and in the Lao States of Siam, into wide billowy, grassy

downs, this subdividing and separating and isolating, which have most affected the Tai character. The Tai extend from Assam to within hail of Canton; they are found from the waters of the Gulf of Siam to far up into the province of Yünnan. They are, beyond all question, the most important race in Farther India or Indo-China, and yet for several centuries they have occupied no more worthy position than that of intruders, as when they supplied kings to Burma; or of confirmed and aimless fighters, as when they quarrelled among themselves and overthrew their own most prominent State with monotonous regularity. The farthest wanderers have become the most settled, but it is apparently only because they forgot that they were Tai. The Ahoms conquered Assam, and even gave it its name, but they, themselves, have been as completely absorbed and assimilated as the Normans were by the Saxons in England. The Siamese were nearly as greatly influenced by the Hkmêr of Chiampa. They took their literature and written character, and many customs from them, including the boot-brush-like, shorn and cropped tuft of hair now worn only by the old-fashioned Cambodian or Siamese, and though their language still retains the most palpable relationship with the Tai speech of the north, they themselves have only realised within quite recent times that they are merely far-wandered Shans.

It is partly the character of the country which they live in, and partly a sensitiveness or susceptibility of disposition, which led them to assimilate with the peoples with whom they came in contact, which has prevented the Tai from taking the place in history which their numbers and occasionally their enterprise warranted. The Ahoms, that is to say "the Peerless," adopted the language, the code of laws, the civilisation, the customs, and even the religion of the people whom they conquered. The second Tai chief became a convert to Brahmanism, and the people are now practically merged in the Hindu population. The Tai in Siam did practically the same; they derived their alphabet, code of laws, civilisation, and many customs from the people whose place they occupied, but since the Hkmêr were Buddhists, they did not change their religion.

Early History.

The Tai have no traditions whatever of prehistoric wanderings. It is possible that they come from Turkistan, but it is certain that they were in the south-western provinces of China when the Burmese migrated. There they occupied, at any rate, the whole of western Yünnan south of the Kinsha Kiang, and gradually extended their boundaries. This area was the kingdom of Nanchao referred to in Chinese annals which have been discovered and translated by Mr. E. H. Parker, late of the Chinese Consular Service. Unfortunately, the Chinese are just the opposite of the Tai. They habitually make their notions of foreign nations conform to their own national custom; consequently they torture the titles of the Shan kings so as to make them fit into the Chinese system of *hsing*, or family names. Thus the names of Si Nu-lo, who about 649 A.D. formed the first Nan-chao kingdom; of Koh Lo-Fêng, who built the city of Tali in 743; or of I Mou-sün, who marched an army far into Ssu-ch'uan, suggest neither modern Shan names nor titles. There can, however, be no doubt that they were Tai, and that in the eighth and ninth centuries they were a formidable military power, and came near to overthrowing the Chinese dynasty of T'ang. Tali was their capital. It was founded in 743 under the name of Yang-tsü-me, and did not get its present name of Tali until 764. The Nan-chao kingdom was a descendant or a continuation of the kingdom of the Ailao, a name still given to the Shans by the people of the north and west of Tongking, and indeed the name by which the inhabitants of the Siamese Shan States still call themselves and are called. The earliest Burmese history speaks of the Pyu, whom the Chinese also called Piao, as being one of the three earliest tribes, the Pyu, the Kanran, and the Sek, that inhabited Burma. They are said, or fabled, to have been welded into one political unit by Kshatriya princes who came over from India and formed the earliest kingdom of Burma. Now the Nan-chao kingdom, and the Ailao dominion before it, are said to have bordered with Magadha and to have had a preponderating influence, if no more, over the Pyu. It is possible, therefore, that these Pyu, of whom no trace can be found, were Tai, or, at any rate, were cognates of the Tai, and that the Shans, even thus early, in the thousand years between 500 B.C. and 500 A.D., when the tribal shiftings were kaleidoscopic and as transient as the floating of a cloud over a mountain peak, were intimately connected with and had a strong influence over Burma. It is possible, there-

fore, that the King Thamóddarit, who in the second century of our era founded a capital and a new dynasty at Pagan, on the Irrawaddy, may have been a Tai.

The first definite name that we have of a Shan king, however, is that of Si Nu-lo, who took to himself the title of "Marvellous Prince and Divine Founder," and built his capital 35 li—say 10 miles—north-west of Mêng-hwa Ting. This happened in 651 A.D., and the five other *chao*, who then ruled States in Yünnan, were all absorbed into the one dominion, with the name of the Great Mêng kingdom, or Southern Chao (Ta Mêng Kuo, or Nan-chao). It is stated that thirty-two princes, covering a period of seventeen generations, had preceded Si Nu-lo in his principality. Besides the six Chao, or princes, there are references to "the thirty-seven tribes," so that even in those days there was the tendency to minute subdivision. Although Si Nu-lo took to himself the title and powers of sole chief, he does not seem to have suppressed the other Chaos. That was left for his great-grandson, P'i Lo-koh, to do. That potentate, who was thirty-one when he succeeded to the throne, apparently found the Chao refractory. He invited them all to a grand feast and sacrifice in honour of their ancestors — a *hsing-hui-chieh*, "the feast of the returning star"—which had originally been instituted in memory of a virtuous Shan widow, who preferred to be burned to death rather than marry an amorous and pressing Chinaman. The feast was an annual function, held in the summer, and the Chaos and their relations had, therefore, no hesitation in coming. P'i Lo-koh had a raised stand built for their accommodation, and when the Chao were all lying drunk upon this, after the dinner, he went down and had the scaffolding surrounded by armed men, and set fire to it. One of the Chao had not come to the festival at all, but the others were burnt to death. P'i Lo-koh's treachery was characteristic of the times, and rather appealed to Chinese ideas, so the King of Nanchao was made Prince of Yünnan, and Duke of Yüeh, which suggests that he had influence in Annam. The battles which he fought, however, so far as is recorded, were against the Tibetans and Mi barbarians, who may have been tribesmen in the country of the Miaotzu.

It was Koh Lo-Fêng, P'i Lo-koh's son, however, who was the first really formidable King of Nanchao. He succeeded to the throne in 748 A.D., and was granted the title of Hereditary Prince of Yünnan, while his son Fêng Ka-i, who had gone to the Chinese Imperial Court, besides receiving a variety of dignities, was given an imperial princess in marriage, and also was presented with a band of Turkish musicians.

The misconduct of a Chinese prefect, however, roused Koh Lo-Fêng's indignation, and he declared war on China; defeated a large army sent against him, seized a number of Chinese towns, and transferred his allegiance or alliance from China to Tibet. In 752 the Tibetans sent him a number of presents and recognised him as a quasi-independent *giulbo*. Two years later Fêng Ka-i routed another Chinese army in the neigbourhood of Tali-Fu, and pursued them as far as western Ssu ch'uan. The Chinese are said to have lost 200,000 men in these campaigns, and Koh-lo-Fêng erected a mausoleum over the bodies of those who had perished at Hsia-Kuan, the commercial town of Tali-Fu.

I Mou-Sün succeeded his grandfather, Koh Lo-Fêng in 778, and, along with the Tibetans, made a raid far into modern Ssu-ch'uan, but was defeated and driven back. The defeat cannot, however, have been very serious, for the Chinese Emperor made conciliatory advances, which I Mou-Sün accepted, and broke with the Tibetans. In 794 he defeated a Tibetan army at the Iron Bridge over the Yangtzu, north-west of Likiang-fu, and was rewarded by the Emperor with a gold seal and the title of King. The Nan-chao State is said to have been bounded in his reign by Chinese Yünnan, Kiao-chi (Tongking), P'iao (Burma), and Tibet.

The next Nan-chao ruler of note was Fêng-yu, who marched as far as Ch'êng-tu, the capital of modern Ssu-ch'uan, and carried off immense booty in the shape of valuables, books, and prisoners. He had to restore 5,000 of his prisoners, but he compensated himself by carrying off 3,000 P'iao, or Burmans, with whom he founded a new city, and in 840 he conquered Annam, at that time desperately misgoverned by the Chinese. It is probably from his temporary holding of the country that the Muong settlements in Tongking date. These Muong are indisputably of the Tai race, as are also the Do of the Caobang neighbourhood.

It was probably on account of this invasion that there was war again between China and Nan-chao, but in 859 the Chinese were disastrously defeated at a point a little north of the Iron Bridge near Likiang-fu. Fighting

with the Chinese went on for several reigns later, but the old Tai dynasty was put an end to, by massacre, in the beginning of the tenth century. As many as 800 persons are said to have been put to death, the whole of the Mêng family and their relations. The dynasty had lasted 255 years from the time when Si Nu-lo established himself, and during this period there had been thirteen kings of Nan-chao. For three and a-half centuries after this Nan-chao was governed by a family of Chinese Shans with the name of Twan. They were more Chinese than Shan, and it seems certain that during all this time the original Tai kingdom was being gradually absorbed by settlements of Chinese in the country. It is, at any rate, certain that parties of Tai from Nan-chao moved southwards and established various principalities in the Lao country, Luang Prabang, and Wying Chan on the Mèkhong, Chieng mai on the Mènam, and others of the many States now existing in Upper Siam. Whether these parties moved of their own accord, or because space was becoming limited on account of the settlement of Chinese colonies, there is nothing to show, but, at any rate, it is very clear that the Tai had spread far beyond their original limits long before Kublai Khan put a final end to the parent kingdom in the end of the thirteenth century.

In the Nan-chao chronicle it is frequently recorded that the rulers received Chinese envoys and generals with Turkish dances and songs, and it is specially noted that in the wars with Tibet, I Mou-sün took prisoners a number of Abasside Arabs and Turkomans of Samarcand. A celebrated Korean in Chinese employ also at this period crossed the Pamirs, and for the first time carried Chinese arms into Chitral, Baltistan, and the whole of that neighbourhood. Through this there came about active political relations between the Caliphs and the Chinese emperors.

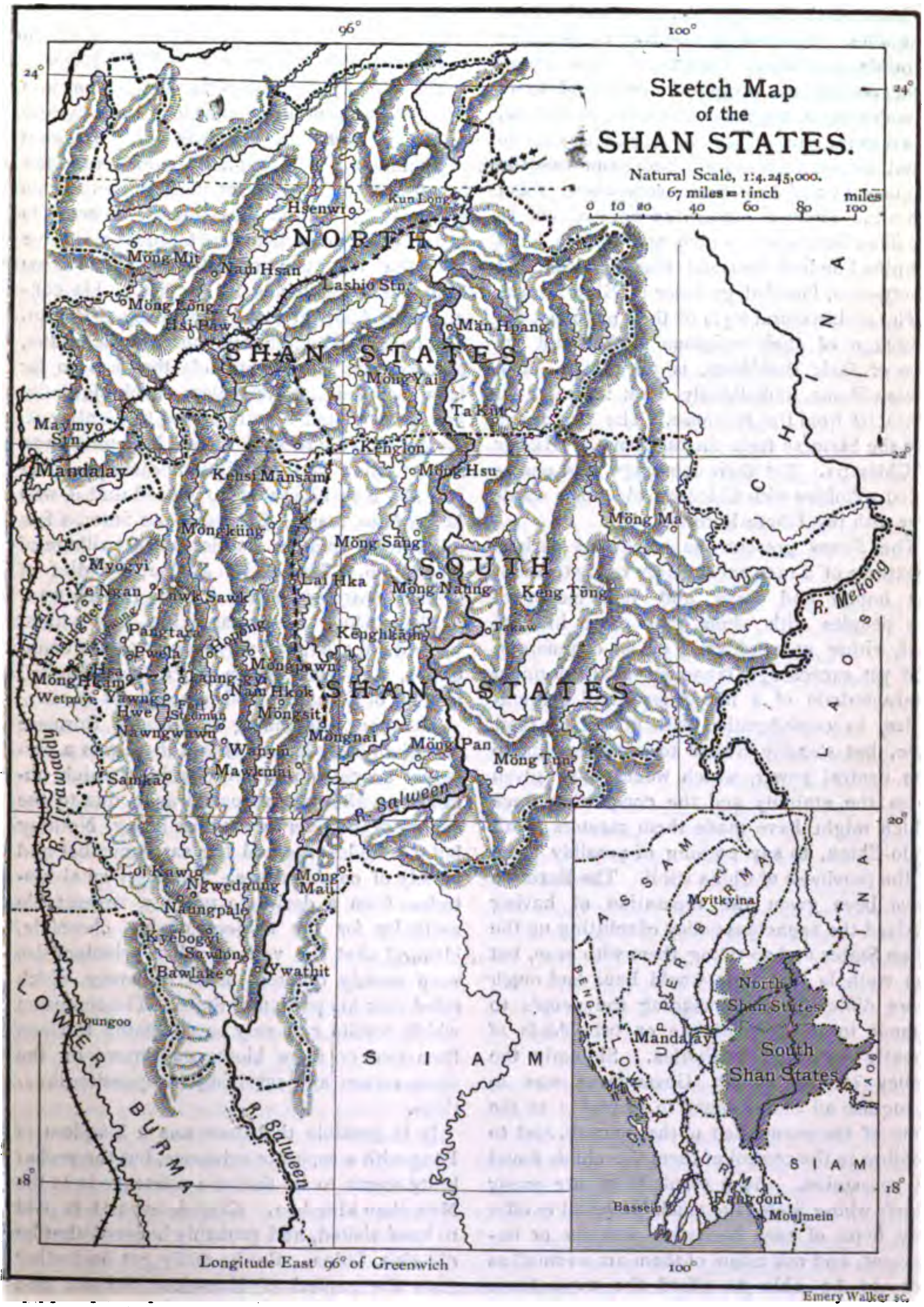
It is, at any rate, probable that the Chinese Mohammedans resident in Yünnan, whom we call Panthays from the name given them by the Burmese, are the descendants of these prisoners taken in the Tibet wars by I Mou-sün and other Nan-chao rulers.

The Chinese chronicle is very curt, very matter-of-fact, and not a little disdainful and ignorant, but from allusions every now and again it seems certain that it was only when there was a particularly energetic man among the Chao that there was one acknowledged head and supreme ruler. At other times the dominion was a confederacy rather than a kingdom, and the formidable power gained during the time of one man of capacity was frittered away when his energy disappeared. If it had not been for this source of weakness it seems well possible that the Tai might have overthrown the Chinese empire, which was struggling to form itself out of a chaos of contending States, and might have established themselves as the rulers of China. But the tendency of the Tai has always been to fritter away their strength. Even at the time of their greatest power constant swarms seem to have left to form new principalities to the south in the valleys between the Salween and the Mèkhong rivers. None of these seem to have rendered any allegiance to the parent kingdom of Nanchao, so far as can be ascertained from the meagre histories and traditions.

Dispersal.

This tendency which all Tai history shows to have been regular and never-ceasing was of course greatly strengthened by the final overthrow of Nan-chao by Kublai Khan. Even if there had been no tendency to migrate before this it would have been suggested now, and the bulk of the people would have left the country where their rulers had disappeared and their national form of government had ceased to exist.

But it seems certain that the general movement west and south of the Tai tribes, which followed the establishment of Uriangkadai in Tali-fu was the mere accentuation of a habit which had long existed, and was not prompted by the conversion of their king into a Mo-ho-lo-tso (or maharajah) and the introduction of Mongol rule. They now proceeded to occupy a great part of Upper Burma, furnished that country with kings, and had a predominant influence for a period of about 250 years. They pressed down to the Gulf of Siam, where they founded the city of Ayulthia, on the site of the ancient Khmêr, capital town of Lawek or Love, and thus completed the separation of the members of the Môn-Annam family, the Peguans on one side and the Cambodians on the other. Since then they have never occupied a prominent position. It is true that Siam is the last of the independent Indo-Chinese kingdoms, but it is, as a kingdom, overlaid with Khmêr culture, hardly admitting itself to be Tai at all, and looking upon the tributary Tai chieftains as people of a distinct race. Although they were much more nearly connected with Chinese civilisation


Sketch Map
of the
SHAN STATES.
Natural Scale, 1:4,245,000.
67 miles = 1 inch
0 10 20 40 60 80 100 miles
NORTH
SHAN STATES
SOUTH
SHAN STATES
CHINA
LAOS
SIAM
LOWER BURMA
R. Irrawaddy
R. Salween
R. Mekong
Hsenwi
Kun Long
Möng Mit
Nam Hsan
Lashio Stn.
Möng Kông
Hsi Paw
Män Hpang
Möng Yai
Ta Kôk
Maymyo Stn.
Mandalay
Kehsi Mänsam
Kenglon
Möng Hsu
Möng Ma
Mongküng
Möng Säng
Myogyi
Lai Hka
Möng Nawng
Keng Tüng
Ye Ngan
Lawk Sawk
Takaw
Pangtara
Kenghkam
Poula
Möngpawn
Wetpyè
Yawnghwe
Nam Hkok
Hwe
Mongsit
Nawngwawn
Möngnai
Möng Pan
Möng Tun
Wanyin
Sam ka
Mawkmai
Loi Kaw
Ngwedaung
Mong Mai
Naungpale
Kyebogyi
Sawlon
Bawlake
Ywathit
Toungoo
S I A M
96°
100°
24°
22°
20°
18°
Longitude East 96° of Greenwich
ASSAM
UPPER BURMA
Myitkyina
BENGAL
North Shan States
South Shan States
Mandalay
LOWER BURMA
CHINA
LAOS
SIAM
Bassein
Rangoon
Moulmein
18°
100°
Emery Walker sc.

and ways than with Indian, yet, beyond their chronology, the Tai have taken very little from the Chinese. The Nan-chao State had a tradition that they got a ruling family from Magadha. Whether that be true or not they certainly got their Buddhism from there. King Asoka, of Magadha, the grandson of Chandragupta, the Sandracottus of the Greeks, was a great missionary king, and it was no doubt he who introduced Buddhism into the Tai country and into Tibet, somewhere about 300 B.C. There are pagodas pointed out in the Shan States now, which are said to be of the nine hundred thousand nine hundred and ninety-nine, founded by order of King Asoka.

The architectural style of their pagodas, the language of their religious works, and the type of their Buddhism, is all Indian. The British Shans, undoubtedly, took their written character from the Burmese. The Lao Shans and the Siamese took theirs from the Hkmêr of Chiampa. Yet their language has undisputed affinities with Chinese, and none whatever with the Tibeto-Burman.

The Shans present the somewhat curious spectacle of a race exceedingly ready to adopt the habits and ways and refinements of the peoples with whom they came in contact, either as neighbours or as conquerors, and yet exceedingly tenacious of the national characteristic of a liking for small communities, in confederation with others of their race, but steadily averse to subordination to one central power, which would have given them the stability and the conquering force which might have made them masters of all Indo-China, to say nothing of possibly some of the provinces of China itself. The Burmese have been given the reputation of having devised the sagacious policy of splitting up the Shan States and so ruling them with ease, but the truth is that they would have had much more difficulty in persuading the people to submit to the rule of one or two chiefs of greatly extended territories. Similarly the policy of the British Government was to recognise all States found in existence at the time of the occupation of the country, and to confirm in the control of them the chiefs found in possession. As a result there are many chiefs whose States are much too small to offer any hope of even becoming wealthy or important, and not a few of them are so small as not to be able to afford the expenditure necessary on main-trunk roads, which pass through their territories. Yet in the few cases where chance has offered a favourable opportunity for the joining together of neighbouring small States, it is the inhabitants of these States who have been most hostile to the project.

Kingdom of Pong and Ko-shan-pyi.

For years no allusion to the Shans was complete without a reference to "the Kingdom of Pông," and to the Ko-shan-pyi, "the nine Shan States." In 1835, Captain Pemberton found a Shan manuscript in Manipur. This was translated and immediately afterwards lost. This chronicle makes frequent reference to "the Kingdom of Pông." The same kingdom is mentioned in the list of his conquests by Anawrat'a, the great King of Pagan. The name is altogether unknown to the Shans, and appears in no chronicle that has so far been recovered. Nevertheless, much ingenuity has been wasted in attempting to identify it. Sir Arthur Phayre said it was Mogaung, now a subdivision of the Myitkyina district. The late Mr. Ney Elias was convinced that it was Mông Mao, a small Chinese Shan State, a few miles away from our frontier market village of Namhkam. Mr. E. H. Parker, by dint of Chinese learning, proves it to be Luh-ch'wan, a place which no longer exists, and which, while it did exist, had very indeterminate boundaries, and was known to a very limited number of Chinamen and to no Shans at all.

The one outstanding fact about Burmese and Shan early history is that there was a perpetual succession of principalities which obtained an alternate preponderance, due to the energy of the ruler for the time being. Nothing but a kaleidoscope had the same number and variety of combinations. But every local historian, from a desire to prove a respectable antiquity for the subject of his chronicle, claimed that the various other principalities were merely different seats of power which ruled over his particular State. The confusion which results can only be compared to views from two or more bioscopes thrown on the same screen and revolving in opposite directions.

It is possible that there was a kingdom of Pông with a separate existence, but the probability seems to be that the reference is to the Nan-chao kingdom. King Anawrat'a is said to have visited, and probably believed that he did visit, China. But he really got no farther than the capital of Nan-chao, Tali-fu, and instead of getting the Buddha's tooth, which he was in quest of, he only got an image which had touched it. On his return, the courtly

chronicle said he had conquered the kingdom of Pông, which really meant that he had visited Nan-chao. Incidentally it is recorded that on the way back he married the daughter of the chief of Möng Mao. Therefore, Möng Mao got entangled with the phantom kingdom of Pông. The incident derived an additional notoriety from the marriage. The king had other wives who were very jealous of the Shan Princess. There were many plots, and she had to go through a great number of trials, but was finally triumphant over her rivals. All this is recounted in a drama, which is one of the most popular on the Burmese stage, and has helped to fix attention on the kingdom of Pông. All that can be said is, that Pông seems to be Nanchao, and that it is possible that Möng Mao was one of the feudatory princes of the southern confederacy.

The name Ko-shan-pyi seems to be more easily explained. Kawsampi is the common classical or Buddhistical name for the Shan country. It is continually used even to the present day. The name was, no doubt, borrowed from Kosâmbi in the Dúab, a famous Buddhist kingdom in Gangetic India. The Burman historian could not bring himself to admit that a Shan principality had a right to a classical title, if indeed he knew that Kawsampi was classical. He, therefore, transformed Kawsampi into Ko-shan-pyi, the nine Shan kingdoms, and then proceeded to speculate as to which these nine kingdoms were. There are lists of the nine principalities given to the present day, but it is never possible to prove that there were not other principalities existing at the same time. In fact, it seems as doubtful that there were, as it is certain that the seven kingdoms of the Saxon Heptarchy never flourished at the same time.

The name and the implied fact of the Ko-shan-pyi was, however, introduced to English readers by Buchanan-Hamilton in the *Edinburgh Philosophical Journal*, and, as a result, Ritter, Burney, Hannay, and many others have given conflicting lists which strove to fix these nine Shan States. Any Shan chief or minister of State will give you a list now, but it is extremely improbable that the lists will agree. It is only one more of the mass of popular errors.

The Various States.

The British Shan States have an area of 59,915 square miles, and are, therefore, a little larger than England and Wales with the Channel Islands and the Isle of Man. They are divided for purposes of administration into two charges, the Northern and the Southern. In the Northern Shan States there are five chiefs, all Sawbwas, and a sixth territory beyond the Salween river which contains the settlements of the Wa, or conglomeration of village communities some federated some independent. In the near future it seems probable that the State of Möng Mit will be added to the Northern Shan States. At the time of the occupation the chief was an infant in arms. He was educated in British schools and his State was administered as a sub-division of the Ruby Mines District. The young chief is now a Cadet and a fair rifle shot, and he has qualified himself for administering justice in his State by holding and exercising second and third class magistrates' powers in various parts of Burma. In a short time now he will be of age and put in charge of his State, and this will no doubt be then added to those under the charge of the Superintendent of the Northern States.

In the Southern Shan States there are forty-three States, five of which, however, are Red Karen, whose independence was guaranteed by us to them in a treaty with King Mindôn of Burma in 1875. The chiefs are, therefore, not on quite the same footing as the Shans. They do not pay tribute and their territories are outside of British India.

Beside the two main groups of the Shan States, there are a few others isolated in Burma proper, which have survived from the time when the Tai empire spread itself all over Northern Burma. Two of these Sinkaling Hkamti and Hsawnghsup, on the Chindwin river, towards Manipur, are quite insignificant, both in size and population. Another is considerably more extensive, populous, and well-to-do, the State of Hkamti Lông. It lies in the Valley of the Mali, the western branch of the Irrawaddy river, surrounded on all sides by the Chingpaw tribesmen, to whom the chief has long paid blackmail to secure protection and immunity from attack.

These States vary enormously in size. Këngtung, with its dependencies, has an estimated area of 12,000 square miles, that is to say, it is about the same size as Belgium, or say the four English counties of Yorkshire, Lancashire, Lincoln and Hertfordshire. North Hsenwi has an area of 6,330 square miles, or only about 1,000 square miles less than Wales. South Hsenwi covers 5,000 square mile, and Hsipaw, with its dependent States, 4,524.

The State of Manglön, with the various Wa States, extend to about 5,000 square miles. Of the others, one is over 4,000 square miles, one is 3,500 square miles; five are over 2,000 square miles, that is to say, they are considerably larger than many of the States of the German Empire. Some, however, are quite insignificant in size; for example, Nam Tôk is no more than twenty square miles, and Kyông is only four square miles larger. There are three States with over 1,500 square miles and one with only seven square miles less. Four States range between 500 and 1,000 square miles. Fifteen have more than 100 square miles and less than 500. Three range between 50 and 100 square miles, and ten have less area than 50 square miles.

In the fifteen States of the Myelat, the intermediate country between Burma and the Shan States proper, there are practically no Shans. The inhabitants are Danus and Danaws and Dayès, and Taungthus and Taungyos, with a number of Karen tribes in the country to the south. Similarly in the Karen-ni States there are only a few Shan settlements here and there, and the State of Hsatung is very largely Pa-o, or Taungthu, including its chief. Similarly in the Northern Shan States the population of Taungpeng-loi-lông is Rumai or Palaung, Manglün is Wa, and considerably more than half the population of North Hsen-wi is non-Shan, a mixture of Chingpaw or Kachins, Palaungs and Chinese. The Shans of Kēng-tung pointedly call those of their race west of the Salween Tai, and reserve the name of Hkün for themselves. Still the Hkün are practically confined to the country round the capital and the Lü, who inhabit, Keng Hung State, also form a large proportion of the Shan population of Keng Hung. They are much more closely allied to the Lao or Siamese than to the British Shans, and their written character was undoubtedly derived from the Cambodians of the old Hkmêr kingdom.

The stretch of country where the Tai are found most continuously and in the greatest proportion, is in that portion which may most reasonably be called the plateau, the broad billowy plain which extends from Mawkmai due north through Möng Nai, Lai-hka, and Möng Nawng, to South Hsenwi. Yet even here there are wide districts where the Riang tribes greatly outnumber the Tai. And everywhere on the ranges which separate the States from one another, there are hill tribes absolutely distinct from the Tai, though subject to and paying tribute to them.

They, therefore, still retain the characteristics of splitting up and isolating themselves which have marked them throughout their history, and have prevented them from attaining to the power which their numbers and their energies would have entitled them to grasp.

The Burmese are usually credited with the policy of dividing them and preventing quarrels between the States, so as to make it the easier for them to govern the Shans and prevent united risings; but it hardly seems that it was a calculated policy. It was the natural bent of the Shan character, no doubt, fostered and exaggerated by the features of the country.

Civil War and Ruin.

For the twenty or thirty years before the occupation of the country by us, however, the States had been in a perpetual ferment of civil war. This began with the southward pressing of the Chingpaw tribes. They steadily overran the great northern State of Hsenwi and occupied quite half its area. The Burmese ascribed this to weakness on the part of the Sawbwa. They put that potentate in gaol and appointed another, and then another, with no satisfactory result. They then varied the process by appointing a series of Burmese civil and military officials with even less advantage, either to their own grasp of the country, or the settlement of affairs. They released some of the Tai chiefs from gaol and re-appointed them one after the other. They also called upon the Southern chiefs to send contingents to fight the Kachins, but the result was never final and seldom even satisfactory, and the State of Hsenwi, which used to be as large and powerful as all the other Cis-Salween States together, was broken up and ravaged and depopulated long before we had anything to do with the country.

Then King Thibaw oppressed and plundered Möng Nai the great Southern Sawbwa, until he rose in revolt and massacred the Burmese garrison at Monè, the largest town in the Shan States, and the residence of the Burmese Governor of the Principalities. The other Sawbwas were then called upon to aid in the punishment of Möng Nai, and he and certain other chiefs, connected with him by marriage and other ties, were driven beyond the Salween and took refuge in Kēng-tung, where the Burmese garrison had been massacred some time before.

British Occupation.

When King Thibaw was dethroned, it was practically a twelvemonth before we took over the Shan States, and in that period the Mōng Nai, Sawbwa, and other exiled chiefs came back to their States and proceeded to wipe off all old scores, and to replenish themselves with their own or other people's plough-cattle out of the States which had joined with the Burmese in expelling them. When, therefore, we took over the Shan States, it was practically in a state of universal ruin. Monè, which within living memory had had ten thousand households, was reduced to seventeen huts, and the town of Laihka was even more thoroughly destroyed.

We met with practically no opposition whatever, and peace was restored by the simple process of marching to the capitals of States, but the rehabilitation of the country has been a much slower matter. For a year or two there was not a little distress, owing to the thoroughness with which the marauding bands had destroyed all seed grain and driven off or destroyed plough-cattle. The fertility of the hill valleys, with their soil yearly renewed by silt washed down from the hills, soon put an end to this, and it was thought that the States would soon recover a certain amount of their former prosperity and attain to even greater wealth.

Trade.

In the old days huge caravans of pack bullocks had travelled about the country carrying manufactured goods and hardware, salt and fish paste, kerosene and candles, and had bought quantities of local produce as they moved about. In Burmese times the roads were far from safe, and there were constant tolls which put heavy restrictions on trade. But the joining together of a number of caravans gave safety against dacoits, and the tolls were not able to kill the trade, perhaps because they were mostly levelled in kind. In those days the Myelat, the half-way country between Burma and the Shan States, did a huge carrying trade. The merchants from below came up to various centres in the Myelat and sold their goods there, and these were then carried by the Myelat bullock caravans to all parts of the Shan States. For a time this was carried on after we took charge of the country, but it has been gradually dwindling away. In place of the thousands of pack bullocks, there are now only hundreds, and the wealthy middlemen of the Myelat have now sunk into a hand-to-mouth existence and often have gone back to the cultivation of the soil.

Part of this is due to the construction of the railway to Mandalay, which has brought goods much nearer to the hills, but a much more serious enemy to the pack bullock men has been the Government cart-road. The carts can go all the year round, whereas the bullock caravans could only travel in the rains when water and fodder were plentiful. Moreover, the carts can carry much more than the bullocks could, and they can travel in twos and threes or even singly. They can also carry goods which could only with great difficulty be loaded on pack bullocks.

It may be thought that all the pack bullock owners had to do was to furnish themselves with carts and carry on their old trade, but the matter is not so simple as that. The training of the pack-bullock to pull at the yoke was not an easy matter. Cattle accustomed to stroll along at their ease under the shade of trees, through bushes and along the cooling beds of streams did not accommodate themselves to the dusty and monotonous ways of the cart road, and where they were accustomed to choose their own paths across a swampy piece of ground they resented the hard and fast narrow limits of a Serbonian bog on the Government road which could not be skirted and was filled with other carts in as unpleasant a plight as themselves. Consequently the pack-bullock owners did not become the possessors of carts. There were soon a number of carts plying, but these were the property, not of the inhabitants of the Shan States, but of Burmans and natives of India, living down in the plains. In the great majority of cases, moreover, these men were not traders, but mere carriers, and with no desire, except to get as much as they possibly could for the carriage of goods. The prices of merchandise were soon very much reduced in the Shan States, but the money for the carriage of them all went out of the country, instead of going into the coffers of native carriers, who would have spent it again in the Shan States. The people paid much less for their luxuries. They had a greater degree of comfort, but they had much less money to spend than they used to have. More over, a great deal of their export trade has been lost. Before the construction of the railway from Toungoo to Mandalay, there was a considerable market for various kinds of produce in the plains. Quantities of dried chillies, onions, cardamoms, and turmeric

were, till quite recent years, sold in the plains. But more and more of these crops have been grown along the railway line, and no doubt more and more are brought from other places. At any rate, the export of the goods has shrunk, until now there is hardly any export whatever, and the cultivators have to reduce their plantings since the local sale practically does not increase at all.

All this, however, would be a matter of indifference if the Shan States were able to take advantage of the crops of which they have nearly a monopoly, crops moreover which have been introduced since the British occupation. It has been proved that the wheat grown in the Shan States is of the most excellent quality, and also that the area where it can be grown is capable of nearly indefinite expansion. By sowing at different altitudes, on different soils, and under varying conditions, wheat could be reaped over two-thirds or three-quarters of the year. Unfortunately, however, the cost of cart hire makes the cultivation impossible. Before the wheat can be got to the railway, the expense of carriage is so great that it cannot be sold except at a loss. Consequently wheat brought at great cost from India for the flour required by the Sepoys of the native regiments is in use in all the military stations in Burma, and the Shan States wheat, which is of admittedly better quality, can only be utilised for the local needs, which hitherto have been very small. A similar state of things prevails in the growing of potato crops. The potatoes grown in the Shan States are of the most excellent size and quality, but potatoes brought from Marseilles can be sold cheaper in Rangoon than potatoes from the Shan States; last season potatoes were selling on the fields in the Myelat for one rupee the hundred viss, that is to say eighteenpence for 370 pounds. But the cost of carriage was nine times that amount, so that when the potatoes got to the railway no profit, or only the most insignificant profits were to be made. Similarly the European fruits and vegetables, which grow in great quantities and of very creditable quality, cannot be exported, partly because cart carriage is much too slow for them, and also because the cost of export is so great that the selling price would be prohibitive.

NECESSITY FOR A RAILWAY.

So far, therefore, the British occupation of the Shan States has been of very doubtful advantage to the traders of the country. They enjoy the blessings of peace; the country is much more accessible than it was, and the chiefs have improved the lines of communication in all directions, but so far from more money coming into the country it seems rather that more is going out, and so far from the prospects for the future being brighter, it seems that they are becoming steadily more discouraging. For some years now the volume of trade has been slowly but gradually decreasing, and last year a considerable falling off in the trade returns was only prevented by an unexpected demand for stick-lac and for horned cattle, neither of which is likely to be maintained.

It might, therefore, be said that improved communications have been a disadvantage to the Shan States, and that, since a cart-road has been of no great help, a railway is not much likely to be more valuable. This, indeed, actually has been said, and the Mandalay-Lashio Railway has been pointed out as a proof not only that a railway to the Shan States will not pay, but that it will not do any appreciable amount of good to the States themselves.

But the Mandalay-Lashio Railway cannot be looked upon as a railway opening up the Shan States at all. It is the beginning of a railway intended to reach Yünnan or to penetrate into the province of Yünnan and beyond. As far as the Shan States are concerned, it merely skirts them as a cat walks round the walls of a room instead of going straight across it. The whole of the country to the north of the railway is a jumble of hills inhabited by Kachins and Palaungs, races who do not trade and never have traded, and do not seem likely ever to become good traders. The Palaungs it is true grow and export tea; they send out a certain amount in the form of dry tea and a still greater amount in the form of salad tea, or pickled tea, a compound which is neither a *hors d'œuvre* nor a *zakouska*, nor a kind of *pan sopari*, and yet has a little of the characteristics of all three. The amount of tea likely to be produced does not seem likely ever greatly to exceed what is produced now, and this amount is very far from employing a large number of goods wagons. There is no other export trade to speak of except what is beginning slowly to grow up from the States to the south-east, and no doubt in time will help to make the railway self-supporting.

The railway follows the line of a geological fault which runs east and west, a subsidence or uprising of the ground which marks the northern end of the M. Nai Laihka plateau,

and is traced across the map by the line of the Nam Tu, a river known as the Myit Ngè, where it enters the Irrawaddy, between Ava and Amarapura. Everywhere else the ranges run north and south. Here the abrupt lines of precipitous cliffs go, as nearly as possible, east and west. It is, therefore, an obvious invitation to a railway which wants to make its way eastwards. But the fault does not extend all the way westwards to Burma. On the contrary, it comes to an end not very far to the south-west of the capital of the Hsipaw State. Though, therefore, this east-west valley is a distinct temptation for a railway, it is a temptation for a railway which is to go on to the Kunlông ferry; to go up the Nam Ting valley; to go into Yünnan; to go to Chung King, and, eventually, no doubt down the Yangtzu to Shanghai, or perhaps across Kuei-chou and Kwang-si to Canton and Kowlun, opposite Hong Kong. It is not the line for a railway which is to be of any special use to the Shan States.

Moreover, in the preliminary approach to this piece of good fortune, it was entirely unnecessary to make for it straight from Mandalay. The ascent to the plateau straight east from Mandalay is at about as difficult a point as is to be found on the whole face of the wall of hills which the Shan tableland presents to the Burma plain. If it is not the most difficult it is, at any rate, far more difficult than very many other lines of approach, and, moreover, it implies the necessity of crossing the abrupt gash which is known as the Gôkteik (or Hokiit) gorge, and is spanned by what was the highest bridge in the world till the completion recently of the Victoria Falls Bridge in South Africa. The Mandalay-Lashio Railway is, therefore, a desperate mistake. It has been ruinously expensive, because it took an altogether unnecessarily difficult route to begin with. It goes through a country which was nearly entirely depopulated in the disturbances which preceded our occupation of the Shan States. It does not serve the Shan States because it creeps along the extreme verge of them, or, at any rate, the extreme limit of the country which is capable of producing valuable exports. It stops short at a point which has nothing to recommend it except that it is the headquarters of the Superintendent of the Northern Shan States. It is a railway which should never have been begun, if it were not intended to carry it on at least to the China frontier, if not into China. Yet it is quoted against the construction of a railway which will open up the Shan States, as a proof that no such railway can be made to pay. The line of approach was adopted because of the attractions of Maymyo, a pseudo-hill station, which merely furnishes a change of temperature and not a change of climate, and possibly also by the attractions which the construction of a formidable bridge had to the professional mind. If, instead, the ascent to the hills had been made from Thazi Junction on the Mandalay Railway, in the Meiktila neighbourhood, the ascent would have been easier; there would have been no big bridge, and the approach to the Kunlông ferry, and Yünnan could have been none the less easily attained in the Hsipaw-Lashio neighbourhood; while the southern Shan States would have had an opening made for them to the railway.

The Southern Shan States Railway Survey.

A survey has been made of this approach to the Southern Shan States from the Rangoon-Mandalay Railway, at a point near Thazi Junction to the neighbourhood of Taunggyi, the headquarters of the Southern Shan States. The length works out to be a little under a hundred miles, and the cost would be about Rs. 67,000 the mile. The survey shows no gradient heavier than one in forty, which compares very favourably with the many gradients of one in twenty-five on the Mandalay-Lashio line. On the other hand, the survey was made for a two-feet four inch gauge, which makes it much easier to take sharp curves than is possible with the three-foot gauge, which is that of all the Burma railways. No doubt the difference in mileage cost between a two-foot and a metre gauge would be considerable, but it seems certain that a good deal of the value of the railway would be taken away if all goods had to break bulk on reaching the trunk line from the Shan States. It would certainly be a great disadvantage in the carriage of live stock, which is likely to be considerable, and still more so in the conveyance of perishable goods, such as vegetables and fruit, which seem likely to be exported in considerable quantities.

Sanction for the construction of this railway is withheld for the present by the Government of India, for the reason that the trade returns do not prove that there would be an amount of freight which would pay for the capital invested, and also for the alleged greater necessity for railways in the delta. The real

reason for these delta railways is that it is supposed they will be much more paying adventures. The Thonzè Henzada-Bassein Railway is practically finished. The Shwegyin Maulmein or Martaban line is to be commenced immediately. The trade returns from this quarter show that there will be an immediate return, but it seems a doubtful policy to duplicate means of carriage in one place, while there are practically none whatever in another. The delta is and always has been well served with a net-work of rivers and creeks, and the railways now constructed and to be constructed can only be rivals to the boats of the Irrawaddy Flotilla Company, and to the coasting steamers of the British India Steam Navigation Company. On the other hand, the Shan States have no outlets for their trade, or only outlets which impose a prohibitive cost.

Registration of Trade.

The Department of Land Records and Agriculture has kept, for some years, stations which are supposed to note the trade coming down from and going to the Shan States. Unfortunately the villages at the foot of the hills where these registration clerks should be posted are extremely feverish for the greater part of the year for all but inhabitants who have been born and brought up there. To avoid losing clerks through fever, or to escape having to pay exceptional wages, the registration stations have all been placed at some distance away from the foot of the hills, and as near as possible to the railway. This is, no doubt, convenient from the office point of view, and might also be satisfactory if all the trade made for the railway. This is, however, very far from being the case. When the carts and the bullock caravans reach the plains they can practically go across country in any direction they please, and they do. The number of carts and bullocks which follow the Government road and come to the Trade Registration Office is not great. It is impossible to say what proportion it bears to the total, but it seems not impossible that it is no more than from two-thirds to a half. Moreover, the registration clerk naturally only remains on duty during the day. During the night the office is closed, and it is precisely at night, at any rate in the dry season, that the great bulk of the traffic passes. The cartmen and the pack-bullock owners prefer to travel between sunset and sunrise, when both they and their animals escape the heat of the sun, and, as a consequence, all this traffic escapes registration. It is not surprising, therefore, that an estimate, from the published records of the traffic, seems to prove that the volume of trade is not sufficient to warrant the construction of a railway. But the records only show a portion of the trade which really does exist; and the confident anticipation of everyone who knows anything about the Shan States is that it is not the expansion of the trade now being carried on that will pay, but the entirely new trade which will spring into existence, whenever there is a means of carrying out the produce.

It may be said that wheat ought to have been grown along the line of the Mandalay-Lashio Railway since it would be so profitable a crop, and it certainly is curious that it should not have been grown. The explanation probably is that there are no cultivators there with the necessary experience. It was only after several years of experiment in a number of different places, and particularly at different seasons of the year, that wheat was grown with any success in the Southern Shan States. Experiment proved that different altitudes required different seasons for planting and reaping. This has to be learnt on the Northern Shan States line, and it would appear that no one there has the energy, or the capital, or the time, or the land to make the necessary experiments. It is also a singular fact that potatoes, which grow so freely in the south, do not appear to do well in the Northern Shan States. However that may be, the fact remains, that in the Southern Shan States the production of both wheat and potatoes will be limited only by the demand, and when they can be exported for a reasonable sum in the way of freight, the demand will be a constantly increasing one. At present all the wheat, or practically all the wheat, consumed in Burma is brought from India at a cost with which wheat grown in the province must naturally compete successfully. At the same time no figures can be shown, for the simple reason that, until there is a market, the wheat cannot be grown. All that can be said is that, any demand, however great, can be met.

Products.

Experiments have also shown that barley and oats can be grown, and if this is the case and oats can be freely produced, there will be an immediate market beyond the province, for the oats grown in India do not run to ear, and are useful as fodder rather than as pro-

ducing grain. It is also obvious that, until there is rapid carriage, the English fruits and vegetables which grow freely wherever they are planted, cannot find a market in the plains. Strawberries can be had for nine months in the year; in fact, the fruit only ceases to form during the period of the heavy rains. Very creditable peaches and apples, and figs are to be had, and the quality of these will, no doubt, steadily improve when it is profitable to attend to the cultivation. Numbers of the chiefs in all parts have planted orchards and vegetable gardens, but at present they are an interest rather than a speculation.

Oranges have always done well in certain parts of the Shan States, and considerable quantities are sold in Burma even now, notwithstanding the heavy rate of carriage, simply because there is no competition, and the price cannot be lowered to the disadvantage of the owners of the Shan orange groves. But with a reduction in the price there would no doubt be a huge increase in the amount sold. Cotton also grows very well in all the drier parts of the States. Great quantities are exported to Yünnan; in fact, almost all the mule caravans returning to China load up with cotton. The staple of the plant now grown is very short, but this seems a drawback which can easily be got over, and the addition of a new producing field may tend to steady the market and prevent the fluctuations which have been so disastrous to the cotton trade of late years. Coffee has been grown with great success by several chiefs, not with any view to sales, but merely as an interest to themselves. There seems no reason to doubt that plantations could be put down and extended to whatever size might be required. The cultivation of tea also seems simply to require the arrival of the planters. Wild tea plants are found in very many places, and all that is wanted is the knowledge necessary to produce a leaf fit for the European market or palate. It is undoubtedly the same with tobacco. At present large quantities are grown in the misty plains of Langkö and Nawng Wôp and elsewhere, but there is no attempt to cure the leaf. It is simply sun-dried, chopped up, and in this way is sold to local smokers. The settlement of planters of experience might not impossibly result in the production of a leaf as valuable as that of Sumatra, which is almost entirely sold for wrappers. Hemp, cinnamon, indigo, and a variety of rubber-producing creepers are also found freely; in fact, there seems very little that might not be grown, if only there were a means of getting the produce to the market in a reasonable time and for a reasonable price. The climate is one which would attract many British settlers if the States were made reasonably accessible.

Minerals.

Very little has been done so far in examining the mineral possibilities of the Shan States. Coal has been found in a great many places. It appears to be lignite in the majority of the fields, but it can hardly be said that the promise of the seams has been properly tested. A few examinations have been made by experts here, and there in places at no great distance from the railway, but they have not been by any means exhaustive, or indeed much more thorough than can be effected by an officer travelling about in a tent with any sort of digging implements that can be got locally and used by people who have never done any pit sinking in their lives. The coal inspected has almost invariably been taken from close to the surface, and is weather or water-worn, frequently both, so that the test cannot be said either to have been a fair or a final one. The best coal-tracts will, no doubt, be found in the limestone hills which run through the centre of the States; but when wheat and potatoes cannot be carried out of the country at a profit, the prospects of coal are very small. The coal found appears to belong to two distinct ages—the upper carboniferous and the tertiary systems. The former is probably not very valuable, but the tertiary coal might be of very good quality.

Iron ore is found in a great many places, and is worked locally in different parts of the States and converted by the neighbouring blacksmiths into *das*, swords, daggers and choppers, and a variety of agricultural tools and household implements. It is characteristic of the Shan States and perhaps of the East generally that the miners never act as blacksmiths. The blacksmiths, in fact, in almost every case, live in their own villages at a considerable distance from the pits where the ore is obtained. The principal iron-working neighbourhoods are Hkesi Mansam, where swords and daggers are chiefly made, and Laihka, where the things made are more for agricultural or domestic use. In the neighbourhood of the Yawnghwe Lake there was formerly a considerable iron manufacture; in fact the State of Pôn-mu, which no longer has a separate existence, in Burmese

times paid its tribute in the form of sword blades.

Grains of gold are found in practically every stream in the country. The sands of the Salween are full of it, and every year in the intervals of agricultural work, parties of Shans encamp on the river and gather enough gold dust to have a festival in their village when they go home again. Many of them do the same thing in local streams, panning out the gold in the crudest possible way in shallow round wooden trays. There is, in fact, no doubt whatever of the presence of gold over very wide areas, and gold-bearing quartz even has been found in several places. The Burmese had a conviction of the existence of gold in great quantities in the form of nuggets in the Shwe-Thamin-Chaung, the Stream of the Golden Deer, in the Wa States, and sent up a large army to occupy the tract. This force had great trouble with the Wa, and was eventually practically annihilated, without even reaching the Golden Stream. A British party, which visited the actual spot in 1897, found nothing tangible, but it was only there for an hour or two, and had no experts with it. At present gold could only be obtained by the expenditure of considerable capital, but it seems not impossible that gold pockets, or deposits of nuggets, may be found. A Burmese clerk, in the course of an afternoon's washing and digging in the banks of a small stream, got nearly an ounce of gold. When this has been done once it may be done by many, and possibly in many places. But the exploiting of the mineral resources of the Shan States must wait for the railway, no less than the cultivation of the soil, and agriculture will probably prove a more valuable, and certainly a more permanent asset than gold-mining.

Extension of Lashio Line into China.

While we have done nothing practical to connect the Shan States with the Rangoon-Mandalay trunk line, we have also done little to give outlets to its trade in other directions. The Mandalay-Lashio Railway is a mere example of faint-heartedness, and the projected railway from Bhamo to T'êngyüeh is only a further proof of the same want of determination. Every year there are hundreds of caravans which come westwards and south-westwards from Yünnan. Some of them come through Ssu-mao and Kêng Hung; some come to Möng Lem, on our Mang-Lön border; some come through Lungling and Nam-hkam; and some come through Yungch'ang and T'êngyüeh to Bhamo. Fifty years or more ago the route most used was the old Ambassador's route, the road which follows the line of the Mandalay-Lashio Railway, and goes on to cross the Salween at the Kunlông ferry, and pass up the valley of the Nam Ting. At that time probably half the Chinese caravans coming to Burma used this route. The ferry at Kunlông was very busy, and there was quite a considerable Burmese settlement on the island in the Salween. Now there are only two or three dug-outs at the ferry, the island is deserted, and Kunlông village is an insignificant place. The disuse of the road began about half a century ago, when the Chingpaw moved south and seized the hills overlooking the Kunlông ferry. They robbed and blackmailed the caravans until the road was given up. We have restored orderliness and good behaviour amongst the Kachins, but we have done nothing on the other side of the Salween. There our Wa tribesmen occupy the hills overlooking the Namting valley on the south, and menace traders with the loss of their heads. The Chinese authorities have lost all interest in maintaining order, and have neither guard stations nor patrols; consequently bands of cattle thieves have established villages in parts of Mōng Ting and Mōng Hkawn, near the old caravan route, and the result is that all trade has ceased, and the only people who use the Kunlông ferry are the Chinese of our frontier district of Kokang, who send an occasional caravan westwards, and the Chinese Mohammedans of Pang Lông, who despatch perhaps one in a year.

But the old route would very soon be resumed if we were to continue the railway from Lashio to the Salween, and up the Nam Ting Valley to some point in Chinese territory. A terminus there would in a short time pass all the caravans. Those from Ching-tung and south-west Yünnan, which now make their way by Ssu-mao to Kèng-tung, would come to the rail-head, and so would the caravans from Tali and Yungch'ang. The mere avoiding of the steamy valley of the Salween and of the desperate climb of six thousand feet up from the river, on the road from Yung-ch'ang to T'êng-yüeh, would be sufficient to determine them in favour of the southern route. The road, in addition to the bald fact of the climb, is in many places a simple staircase, hewn out of the solid rock. No beasts of burden, except the goat-like Chinese mules and ponies, could get over it. The point which should be aimed at is at present uncertain, because only one

route has been surveyed, and that in a very sketchy fashion. This route was indicated by the valley of the Nam Ting, which carries it right up to the Mèkhong watershed. It was first traversed by Captain H. R. Davies, a very capable officer of the Indian Intelligence Department. His object was to get to Tali-fu, and he, therefore, took the shortest way there. The interim terminus which he suggested was either Shunning-fu or Yün-chou, but, if it is intended to carry the line on farther, the descent from here to the Mèkhong by one stream and the ascent on the other side to Tali-fu would be very formidable. A better line would seem to be to leave the Nanting valley at some point short of Shunning-fu and to cross over to the Nam Hsüng valley. The Nam Hsüng is a very considerable river, which would take the railway with no great difficulty down to the Mèkhong.

Disadvantages of Bhamo-T'êng-yueh Line.

This railway would be infinitely better worth constructing than the line which it is seriously talked of making to T'êng-yüeh from Bhamo. This railway would find no very formidable difficulties in its construction, but it would touch the merest edge of the province of Yünnan; it could not be carried beyond that place except by the construction of the Mont Cenis tunnels and Menai bridges with which Colborne Baber confronted prospectors a quarter of a century ago; it would not attract the caravans from the south-western part of the Yünnan; and, finally, it would not connect with any of the existing lines in Burma, but would end at Bhamo, where the river navigation is becoming more and more difficult every year in the season of low water. The extension from Lashio, even if it went no further than the limit of British territory on the other side of the Salween, would attract caravans from all over western Yünnan; it would connect with the Burma railway system, and it would convert a line, which at present is worked at a serious loss, into one with very great hopes for the future. It would, moreover, give the Shan States a route for the export of its goods to China by a back door, as the Southern Shan States Railway would give one by its front door, in place of the painfully inadequate outlets which the States now have. For this reason the proposed Bhamo-T'êng-yüeh line is a very dangerous temptation, because it diverts attention and capital from the true route. It would probably put off the construction of the Kunlông Railway for years, and would substitute a route ending in a *cul-de-sac* for one having the whole Chinese Empire in front of it. For this reason, a proper expert survey of the country between the Salween and the Mèkhong is necessary, and a further survey of the route through Hsen-wi, by the watershed of the Salween and the Irrawaddy, up the valley of the Nam Tu, is wanted, instead of the present very costly line surveyed down the valley of the Nam Kek, and up the banks of the Salween to the Kunlông ferry.

We are accustomed to talk patronisingly of the way in which the French manage their colonies; but in the way of railway construction they are proving much more enterprising than we are. The deadly sub-montane country between Laokai and Mêng-tzu has killed great numbers of coolies and navvies, and has seriously retarded the construction of their line towards Yünnan-fu; but it is progressing steadily, and will do so rapidly when the highlands of Yünnan are reached.

Improvement of Water Communications.

But it is not merely in the way of railway enterprise that the French give us an object-lesson. They have also done a very great deal to utilise the Mèkhong as a water-way, whereas we have done absolutely nothing with the Salween river which in the same latitudes is a larger river than the Mêkhong. It is true that the *Hat-gyi*, the great rapids, ten miles below the mouth of the Thaungyin, are quite unnavigable, and that the rapids extend over a distance of more than ten miles. But it would be quite possible to construct a light railway to pass these rapids, as the French have done at the rapids of Hkawn, or Li-pi, with a 3½ mile railway across the island of Khong. These Hkawn rapids are quite as formidable though of a different character from the *Hat-gyi* of the Salween. In the Salween the rapids are formed by the presence of bars of rocks stretching right across the river, with falls of from five feet up to twenty feet or more. In the Hkawn rapids a number of islands break up the Mèkhong into a series of channels, which in the season of low water are studded with rocks, and the total fall is estimated at sixty feet. The French had made the rapids of Preapatang, some distance below, navigable by means of extensive blasting

operations, and they continued these at the Hkawn rapids. But it was found that in addition to the magnitude of these works, they were likely to seriously reduce the depth of water in the channel above, so the blasting work has stopped and a portage was substituted. The result is that French-built launches go up to Suvannakek and Wying Chan (Vientian), and goods can go on from there to Luang Prabang and Chieng Khong by native boats. Long reaches are practicable for steam launches, and if the upper, less formidable rapids are blasted, it is not improbable that steam launches will be able to go up past Luang Prabang and Chieng Khong to Chieng-hsen and our frontier. The work of the French is all the more public-spirited and praiseworthy, because it is admitted in the Reports that the trade is in the hands of Chinamen, Germans, and Swedes.

In the case of the Salween, a not inconsiderable existing boat traffic shows us the line we ought to follow. Every year a number of trading boats, simple dug-outs, go down from Mawkmai and from the Karen-ni States to the village of Kyaukhnyat, in the Salween hill tracts. There the goods are landed and taken over a ridge to Papun, whenever they go down the Yônsalin river to its junction with the Salween and so ôn to Maulmein.

If a light hill railway, worked by a power station established on the Salween, were built, steam launches put together at Kyaukhnyat, would have a clear stretch of the Salween between two and three hundred miles long before them and would draw practically the whole trade of the Karen-ni, Mawk-mai, Möng Nai and Möng Pan States. Inspection of the formidable Tang Kao-tek rapid in the Möng Pan State might result in the discovery that it could be made navigable by means of blasting operations, and if this were effected, another rapid, the Tang Löng, would offer no very serious difficulties, and launches would reach the Kaw ferry, where the main Government road crosses the Salween. The advantage in rendering Kèngtung more accessible and in reducing the present enormous cost of rationing the garrison there would almost alone seem to justify the undertaking, but so far nothing in the way of a hydrographic survey of the river above Kyaukhnyat has been undertaken. A flotilla of the kind would in no way interfere with the prospects of the railway, and would probably add considerably to the commercial activity of the Port of Maulmein.

Question of Revenue.

Twelve years ago a paper was read before this Society by Sir Herbert Thirkell White, the Lieutenant-Governor-designate of the province. He referred to the care and cheapness with which the Shan States were governed, and to the interesting character of the experiment which was being tried. The experiment still goes on. The States are not feudatories, but actually part of British India. The chiefs have the power of life and death, and so long as their actions are in conformity with justice, equity, and good conscience they have practically unlimited power in the management of their States. The chiefs are under the guidance of the Superintendents, and have to obey their orders if occasion should arise to issue them. Hitherto practically nothing but advice has been required, and the country has remained quiet and wonderfully free from crime of a serious description. The number of political officers in the States has slightly increased, but the garrison remains the same in number, and military police have, within the last month, been substituted for the last remains of the sepoy garrison. The Shan States have always been very cheaply held, and the expense is no greater now than ever it was, but the tribute received by no means covers the expenditure. It does not seem likely that it will for very many years, unless we provide them with communications which will enable them to develop the very considerable potential wealth which at present tantalises them. The wants and desires, and even the needs of the people, have vastly increased since we took over the States eighteen years ago. Peace has been completely established, internal communications have been made comparatively easy, partly by Government, and very considerably more by the works undertaken by the chiefs. But the wealth of the country has only so far increased as is implied by the establishment of a stable Government, and there are signs that it is now almost stationary.

Great numbers of the people have paid visits to the plains, and have seen the constantly increasing prosperity of the towns and villages of Burma. All the chiefs have been to durbars in Mandalay or Rangoon. Seven of them went to the Imperial Durbar at Delhi. There they saw what wealth can do, and they acquired a taste for expenditure without any increased means of meeting it. There are not wanting signs that they are endeavouring to get more revenue out of their people than the

people can afford, or the sanctioned budgets allow. At the same time the people have discovered new outlets for their money, and have acquired new tastes. They know that there is a market for their potatoes, if they can get them down for a reasonable price; they know that they could make large profits if they could get their wheat to the railways. They believe that Burma is more wealthy than they are, simply because it has railways. Therefore, the whole population, chiefs and people, clamour for a railway as the only hope of the Shan States, and there are not wanting people who believe that the building of the railway would be a very profitable speculation for ourselves, although it cannot be proved by figures.

DISCUSSION.

The CHAIRMAN thought all would agree with him that they had listened to a most interesting paper. Sir George Scott had not only given a succinct history of the Shan States, their customs and their present condition, but he had made some very useful suggestions for the future. The author had quoted the statement that the acquisition of the Shan States on the part of the British nation was an interesting experiment; it was by no means the first of its nature that had been conducted, and he (the Chairman) trusted that it would prove no less successful than its predecessors. About ten years ago, at the Society of Arts, it had been suggested by a predecessor of his that Sir George Scott should put into a paper the results of his observations and of his work, and the treat the author had given them that afternoon was well worthy of the suggestion that was then made. They were all aware that Sir George Scott belonged to that great body of men who had shown both courage and presence of mind in the face of sudden and serious difficulties. Indeed, if he had not shown that courage and presence of mind on a certain occasion, it was doubtful whether they would have had the privilege of listening to him that afternoon. The great interest which had always been taken by this country and by our representatives in the peoples in their care, in their histories and their customs, was an evidence of the qualities which had enabled Britain, not merely to govern its various dependencies and colonies, but to draw to our rule not only the respect, but the sympathy and affection of the subject races of the Empire. He trusted that the result of the paper would be to deepen and to emphasise that interest which the great mass of the people of the British nation felt in the experiments which were going on continually throughout the Empire.

Sir FREDERIC W. R. FRYER, K.C.S.I. (late Lieutenant-Governor of Burma), thought that they had been very fortunate in getting Sir George Scott to read a paper on the Shan States, for he did not know of any English officer who knew more about them. He had served both in the Northern and Southern Shan States, and had always taken a great interest in the people and in the country, and the result of his labours had been made very clear that evening. He had told them that when the British assumed the government of Upper Burma the work of pacifying the Shan States was a very easy one, and that the British officers had only to appear in the different States for them to submit. His (Sir Frederic Fryer's) recollection of that time, however, was not quite exactly the same as that of the author. His (the speaker's) impression was that the work was one of considerable difficulty, and the fact that it was accomplished with so much ease redounded very greatly to the credit of the officers who were charged with the pacification of those States. Amongst those officers he was sure none deserved more credit than Sir G. Scott. It would have been very interesting if the author had told them something of his expeditions into the country of the Was, and also something of his experiences on the three Boundary Commissions on which he served. Speaking for himself, he knew he had been very anxious sometimes as to what would happen to Sir George Scott when he plunged into those wild countries. On several occasions he had met with very serious resistance, and it was only through the courage and presence of mind of Sir George Scott and the officers who served with him that they were able to avoid serious misadventure. On one occasion in the Wa country they were attacked by a very large force, and only emerged after very serious fighting with very great difficulty. But the audience had not been told any of those things; he supposed that Sir George Scott was too modest to tell them of the very serious difficulties he had to overcome in the course of his service in the Shan States. He (the speaker) had visited the country described on several occasions, and could endorse all that the author had said about the necessity for a railway to the Southern Shan States. He was himself very much impressed with that necessity, and, with some difficulty, procured sanction to have a survey made of the railway. The survey was not finished in sufficient time for him to procure the sanction of the Government of India to begin the construction of the railway, but he had heard from his successor, Sir Hugh Barnes, that he had strongly advocated its commencement. Sir Hugh Barnes had also stated that the former trade returns were exceedingly faulty, and that he hoped to be able to show that the traffic was very much greater than was supposed. Personally, he (Sir Frederic Fryer) was convinced that the railway would pay, and he was of opinion that, even if it did not pay, it ought to be constructed in order to remove the many and great disadvantages which the people of the Southern Shan States suffered from. The line to the Northern Shan States was

never expected, by any person who knew anything about it, to be remunerative, having been made solely to open out trade with China. When it was found that the line was exceedingly expensive and that the advisability of continuing it into China was open to doubt, the work was stopped at Lashio. A line running to Lashio was no good as far as trade was concerned; it was of some slight use politically, as it opened out the Northern Shan States. He was informed that the line did pay as far as Maymyo, but beyond that it ran mostly through a barren and uninhabited country, and unless it was continued to China he did not think there was any prospect of it ever paying within any measurable distance of time. With reference to the line which was contemplated from Bhamo to Tengueh, he had a certain amount to do with it before he left Burma, and although it was quite possible to make a line to Tengueh, beyond that place the country was impracticable, except at an expense which would be prohibitive. He was glad to say that the Shans had now practically settled down as peaceful subjects of the British Empire, and it would be very instructive if those present could see the sons of the Shan chiefs in the school at Taungyi, which had been a great success. He was quite sure the influence of education would spread over the Shan States, and when they got their railway—which they must do in time—the prosperity of the Shan States would be restored to what they had been told it was in former times.

Major H. R. DAVIES thought that to those who knew the Shan States it must have been a great pleasure to hear the country and its inhabitants so well described by the author. He thought he could say without fear of contradiction that there was no greater authority on the subject than Sir George Scott. He was glad to hear him allude to the fact that the Shans were a very numerous and widely-spread race. The few people in England who had heard of the Shans looked upon them rather as some small hill tribe on our eastern frontier; but, as the author had said, they occupied the whole of Siam, and what were now called the Shan States, and they also spread out a great deal westwards as far as Assam. Besides this they formed a very large part of the population of four of the Chinese provinces, viz., Yunnan, Kwei-chou, Kwang-si, and Kwang-tung, which were in the south-west corner of China, but. as far as three out of the four were concerned, they had not been explored enough at present for them to know how much Shan population there was in them. Even if they had accurate information on that point it would not give an adequate idea of the real extent of territory that the Shan race originally occupied. He thought that a great many of the Chinese of southern and western China had really more Shan blood in them than they had Chinese. Those who knew the Shans would have noticed the great facial and physical resemblance between them and the southern Chinese. If one were to suggest to a Cantonese Chinaman in the present day that his ancestry went back to the Shans, he would consider it an insult. He thought, however, that this was only a proof of the very thorough way that the Chinese could assimilate foreign tribes. It was recorded in Chinese history that the whole of the south and the west of China was originally inhabited by non-Chinese tribes, and it was only within the last few hundred years that the Chinese had penetrated to any great extent to a considerable part of the country. They had penetrated partly by conquest, followed by the planting of soldier colonists among the Shans and other tribes. These soldier colonists had naturally taken wives from the country, and the result had been a mixed race with a great deal more aboriginal blood in them than Chinese blood. Moreover, peaceful emigrants from time to time went from China and settled amongst these tribes, pressed on probably by the difficulty of getting a living in the more populous parts of China, and the influence of China had gradually spread in that way. All this was not mere theory, because the process could still be seen going on in Western China. In Yunnan up to the present day one could see tribes in all stages. There were some of them who still retained their language and customs, and knew no Chinese; there were others who, as Chinese influence spread, gradually began to talk Chinese and adopt Chinese customs. The final result was a most correct Chinaman, who, after a generation or two, would quite forget that he had any other ancestry than the Chinese; in fact, he would resent it if anyone suggested the contrary. The real independent Shans were still under their own chiefs and spoke their own language. In other places one found a mixed population of Shans speaking Shan, and Chinese speaking Chinese. In that case the Shans were generally under a chief of their own, but the Chinese of the place were under the district official of China. A little later they all became real Chinamen, and the place would become a Chinese district. There was one thing that had tended to save the Shans from being swamped by the Chinese, viz., the climate. The Chinaman of Western China —he could only speak of Yunnan—was accustomed to a height of 6,000 feet, and to a very pleasant country, and thought no place was fit to live in that was under 4,000 feet. Consequently, the Shans were left undisturbed in the lower-lying valleys. As Sir George Scott had mentioned, both in the Shan States and in Yunnan there were a great number of other tribes besides Shans. He thought it was a great pity that some individual inclined that way, or some learned society, did not study those tribes. The philology of that region was well worth taking up, because for the languages of that part of the world there still remained to be done what Max Müller and others had done for the Aryan language. So far this had been left principally to travellers and frontier officials, who had not time to take the matter up thoroughly. If any

learned society would undertake this work he thought they would be well repaid.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Sir George Scott for his admirable paper.

INDUSTRIAL ALCOHOL.

The Report of the Departmental Committee on Industrial Alcohol (Cd. 2,472) has just been issued and is both interesting and important. The Committee was appointed by the Chancellor of the Exchequer "to inquire into the existing facilities for the use, without payment of duty, of spirits in arts and manufactures, and in particular, into the operation of Section 8 of the Finance Act of 1902, and to report whether the powers conferred upon the Commissioners of Inland Revenue by this section permit of adequate facilities being given for the use of spirits in manufactures and in the production of motive power, or whether further facilities are required; and if it should appear to the Committee that the present facilities are inadequate, to advise the further measures to be adopted, without prejudice to the safety of the revenue derived from spirits, and with due regard to the interests of the producers of spirits in the United Kingdom." In interpreting the terms of reference the Committee considered that the main objects of their inquiry were to ascertain the extent to which alcohol is, or might be, employed in arts and manufactures, or in the production of heat, light, or motive power, and to determine the conditions of greatest freedom that could be accorded to its use for these purposes, consistently with adequate safety to the revenue derived from spirit as an article of human consumption.

The use of methylated (denatured) spirit duty free was first authorised in 1855 by the Act 18 and 19 Vict., c. 38. The present law on the subject is contained in the Spirits' Act, 1880, as amended by the Customs and Inland Revenue Act, 1890, and Section 8 of the Finance Act, 1902. Up to 1855 spirit could not be used duty free by the public under any circumstances. From that year until 1861 it could be used duty free for manufacturing purposes only, if methylated according to the prescribed process. From 1861 to 1891 spirit could be used duty free for any purpose other than consumption directly or indirectly as a beverage, or internally as a medicine, provided it was mixed with wood-naphtha to the extent of one-ninth of its volume. But if used in large quantities, as for manufacturing purposes, it could not be purchased from a retailer of methylated spirit but only from a methylator, and the user was subject to Excise supervision. From 1891 to 1902 the use of this kind of methylated spirit was confined to manufacturing purposes, subject to the same conditions as before, while for general purposes a spirit consisting of the above spirit with an addition of ·375 per cent. of mineral naphtha, and known as "mineralised" methylated spirit, was brought into use. It is only in this spirit that retailers are permitted to deal. Since 1902 the two kinds of methylated spirit have continued to be used as before. But an alternative to their use has been opened to manufacturers under which spirits may be employed after being subjected to some special process of denaturing, appropriate to the particular industry, or possibly even in a pure state, should circumstances be held by the Board of Inland Revenue so to require.

The Committee say that advantage has been taken of the Act of 1902 by a certain number of manufacturers, "but in examining the witnesses that have come before us, we have been surprised to find in some quarters a very inadequate acquaintance with its provisions, and much failure to appreciate its significance." The "ordinary" methylated spirit is open to certain objections as a material or instrument of manufacture. In a few cases it is unsuitable owing to the chemical properties, or of the smell of the wood-naphtha it contains. And it is always open to the disadvantage that it is somewhat heavily enhanced in cost as compared with pure spirit. For not only does the wood-naphtha, which must be present to the extent of 10 per cent., cost more than double the price of the equivalent quantity of spirit, but now and again it tends to make the mixture less efficient for the purpose in view than it would be without this ingredient. It was to meet these objections that legislation was undertaken in 1902, and the Committee consider that Section 8 of the Finance Act of that year does all that is possible in respect of the character of the spirit. It has removed all difficulty in the way of procuring a spirit suitable in character for any industrial purpose. It has also to some extent lessened the objection on the score of cost, inasmuch as the special processes of denaturing authorised by the Board of Inland Revenue are becoming less expensive to the manufacturer than is the case with "ordinary" methylated spirit. On the other hand the cost of these processes is enhanced by the charges for Excise supervision.

But the cost of denaturing touches a part only of the question of the price of the spirit used for industrial purposes. A more potent influence on price is found in the conditions under which spirit can alone be manufactured in this country. The duty on spirit used as a beverage in the United Kingdom is very heavy, and in imposing this duty it is essential to the protection of the revenue to impose on the manufacture of spirits such restraints as may be necessary to prevent any spirit from escaping payment of duty. A consequence of such restraints is to cause an appreciable enhancement of the cost of manufacture, the measure of which is not susceptible of positive determination. For its purpose the Committee assume an enhancement of the cost of producing plain British spirits by 3d. the proof gallon, or an increase of about 50 per cent. on the cost that would otherwise prevail in the production of industrial

alcohol. The final result upon the cost of industrial spirits of all the measures taken to protect the revenue is given by the Committee as follows:—Spirit used in manufacture is commonly about 64 over-proof, and is plain spirit. The price of a bulk gallon of the spirit is about 5d. more than it would have been but for Excise restrictions. The cost of methylating is put at between 3d. and 4d. per bulk gallon, so that of the price eventually paid by the manufacturer, which at present may be taken at from 20d. to 22d. per bulk gallon for large quantities at wholesale price, about 8½d. is attributable to precautions on behalf of the revenue. In the opinion of the Committee, the conditions in which the spirit must be used, and the price at which it can be procured, affect different industries in very varying degrees. Either consideration may be of vital importance to a particular industry, but speaking generally, and taking the whole range of industrial enterprises employing alcohol, the question of price is infinitely the more important of the two. A difference of, say, 6d. per bulk gallon in the price of alcohol may make all the difference between profit or loss in the carrying on of an enterprise.

The coal tar colour industry figured very prominently in the discussion which led up to the appointment of the Committee. It was said that this industry, which originated in this country, and at one time flourished here, has been lost to us very largely, if not mainly, by reason of the obstacles in the way of a cheap and untrammelled supply of alcohol. The Committee went into the evidence very carefully, and are satisfied that, "regarded as a statement of historical fact, the assertion that the coal tar colour industry has been lost to this country on account of obstacles to the use of alcohol is destitute of substantial foundation." In the earlier days of this industry alcohol was used almost wholly as a solvent, and for that purpose methylated spirit is suitable. Moreover, when alcohol first began to be used as a constituent of dyes, and until some time after the decadence of the industry in this country had become marked, the price even between duty free and duty paid alcohol was a matter that could practically be left out of consideration. In the opinion of the Committee "the cause which predominated over all others was the failure of those responsible for the management and for the finance of the industry here, during the years 1860-80, to realise the vital importance of its scientific side, and their consequent omission to provide adequately for its development on that side." In at least 75 per cent. of the whole industry alcohol does not enter into account even now, and these branches could be prosecuted in this country, as indeed they now are, whatever the conditions in regard to the use of alcohol might be. "Nevertheless," say the Committee, "even where alcohol is not immediately required for the manufacture of a dye stuff, the utilisation of waste products, and the development of new methods, may be hampered by the want of alcohol; while for the dye stuffs for which alcohol is essential, its price and the conditions of its use are matters of great moment. We are of opinion, therefore, that if the hope is to be entertained of recovering any considerable portion of this trade more favourable conditions must be established in respect of the use of alcohol."

The evidence as to whether in the smokeless powders industry ordinary methylated spirit is unsuitable or detrimental in character is described by the Committee as "conflicting and inconclusive." But the question of the price of spirit and ether is one of vital importance to the manufacturer of smokeless powder, of which nitro-cellulose is a constituent. The quantity of alcohol used, either directly in the form of spirit, or indirectly in the form of ether, for the production of one pound of this powder, is very large. The witness gave the Committee to understand that a difference of 6d. per gallon in the price of spirit would make a difference of 7d. per lb. in the cost of the powder produced, and it is manifest that a much smaller difference than that would turn the scale between profit and loss. In pharmaceutical products again alcohol plays a very important part. In Section 4 of the sub-committee's report the subject is very fully treated. The Committee content themselves with observing that "for a large and probably increasing number of substances, such as the synthetic perfumes, antipyrine, phenacetin, sulphonal, and so on, alcohol at a price not in excess of that at which it stands in competing countries, and usable under conditions not inimical to to the quality and character of the compounds provided, is essential to the existence of the industry." The production of ether again has become a most important industry, and seeing that it requires much more than a gallon of strong spirit to produce a gallon of ether, the price of spirit is manifestly a condition of primary moment to this industry. And so with artificial silk. This industry is not at present prosecuted in this country, but it employs many thousands of workpeople on the Continent. Here again the price of alcohol is a consideration of vital importance, as the combined ether and spirit required to produce one pound of the finished article represents nearly a gallon of strong spirit.

The general conclusions arrived at by the Committee may be summarised as follows:—(1) That used for general and universal purposes "mineralised" methylated spirit is quite satisfactory both to the revenue and the public in respect of character, and that at present no better method of denaturing is available. As to price, the regulations in regard to distribution might be appreciably relaxed in respect to the quantities that retailers may keep in stock, or may sell at any one time to a customer. (2) That where spirit is used for industrial purposes the Finance Act of 1902 works well. (3) That something more is required in order to place spirit used as an instrument or a material of manufacture on a footing satisfactory in the matter of cost. Anything in the nature of a bounty is undesirable, but seeing that on the price of spirit the very existence of certain

industries may depend, and that for all industries using alcohol the price of spirit is an important factor for the future of trade that lies outside the home market, it is desirable to make such arrangements as will free the price of industrial spirit from the enhancement due to their indirect influence of the spirit duties. The only way to do this is by granting an allowance on such spirit at such rate as may from time to time be taken as the equivalent of the increase in cost of production due to revenue restrictions. At the present time the rate is taken at 3d. per proof gallon for plain spirits, and the allowance would accordingly be at this rate, and should be paid equally on all industrial spirit whether it be of British or foreign origin. (4) That "ordinary" methylated spirit should contain only 5 per cent. of wood-naphtha, instead of 10 per cent. (5) That no charge should be made on manufacturers for the regular attendance of Excise officers to supervise denaturing operations, or the use of denatured spirit, in factories taking the benefit of Section 8 of the Finance Act, 1902. (6) That in the manufacture of fine chemicals and pharmaceutical products spirits specially denatured should be allowed only where the manufacture is kept entirely separate from the manufacture of tinctures and other preparations in which spirit remains as spirit in the finished product. (7) That an allowance be granted to all industrial spirit whether of British or foreign origin at the rate from time to time prevailing for the allowance to British plain spirits on export. (8) That the imported methylic alcohol be relieved from the obligation to pay the surtax imposed by Section 8 of the Finance Act, 1902, and that methylic alcohol be given favourable treatment in the matter of denaturing.

GENERAL NOTES.

PRIZES FOR DYEING.—The Council of the Society of Dyers and Colourists announce that funds have been placed at their disposal for distribution in the form of prizes for the solution of technical problems. The following prizes are now offered:—1. £10 for a satisfactory systematic tabulation of the reactions of dyestuffs on the fibre, and a comprehensive scheme for their identification on dyed fabrics. The scheme should include the principal colouring matters dyed singly on all fibres for which they are employed. Competitors may adopt any method of classification they think desirable, but it is suggested that one or two reagents only be used as group tests, other reagents being subsequently applied for distinguishing the individual colours in a particular group. 2. £10 for a reliable method of distinguishing between unmercerised and mercerised cotton of various qualities, and for the estimation of the degree of mercerisation without reference to lustre. 3. £20 for a full investigation of the causes of the tendering of cotton dyed with sulphide blacks, and the best means of preventing such tendering. 4. £20 for a satisfactory standardisation of the strength and elasticity of cotton yarns of various qualities and twists in the grey and bleached conditions. 5. £20 for a full investigation of the average degree of tendering brought about in cotton yarn of various qualities by—(a) cross dyeing with acid colours; (b) dyeing aniline black; and (c) various other dyeing processes, with the object of fixing standards for the trade. Further information can be obtained from the hon. secretary, Mr. Ernest T. Holdsworth, Westholme, Great Horton, Bradford.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MAY 3.—"Recent Excavations in Rome." By MRS. BURTON-BROWN.

MAY 10.—The Native Races of the Unknown Heart of Central Africa." By VISCOUNT MOUNTMORRES. J. CATHCART WASON, M.P., will preside.

MAY 17.—"The Use of Wood Pulp for Paper Making." By S. CHARLES PHILLIPS, M.S.C.I.

MAY 24.—"Modern Lightning Conductors." By KILLINGWORTH HEDGES, M.Inst.C.E., Hon. Sec. to the Lightning Research Committee.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 11.—"The Manufactures of Greater Britain.—III. India." By HENRY JOHN TOZER, M.A.

MAY 18.—"Plague in India." By CHARLES CREIGHTON, M.D. SIR DENNIS FITZPATRICK, K.C.S.I., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MAY 2, 4.30 p.m.—"The Monumental Treatment of Bronze." By J. STARKIE GARDNER, F.S.A. SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., will preside.

MAY 16, 4.30 p.m.—"Excavation of the Oldest Temple at Thebes." By H. R. H. HALL, M.A.

[Mons. Lalique (of Paris) is unable to read his paper on "Popular Jewelry" which was announced for this date, and Mr. Hall has kindly undertaken to read the above paper in its place.]

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

LECTURE I.—MAY 1.—Application of the term embroidery to methods of working ornamentally with threads—Specimen of Egyptian embroidery, 1450 B.C.—Correspondence of its method with that of much Greek and Roman embroidery—Embroidery as an occupation in Greek houses, and as a trade in Rome—Embroidery in Benedictine monasteries and convents—The relation of illuminations in MSS. to designs for embroideries—The Dalmatic of Charlemagne, and suggestions of its figure designs being derived from Frankish illuminations of the 9th century—Comparison of designs for Bayeux tapestry, with outline figure drawings in MS. of Ælfric's Pentateuch.

LECTURE II.—MAY 8.—Embroidery in England, 12th and 13th centuries—MS. illumination, painting and embroidery as secular arts in 13th and 14th centuries—Influence of work in one art craft (the Goldsmiths') on that in another (Embroiderers')—Types of ecclesiastical English embroidery 13th, 14th, and 15th centuries, compared with contemporary illuminations in MSS. — Designs for English embroidery gradually affected by developments in ornamental weaving abroad—Symmetrical and floral patterns taking the place of designs with figure subjects having an epical or story-telling interest—English secular embroidery of the 16th and 17th centuries—The "conceits" in embroidery of the Elizabethan and Stuart periods—Embroidery in costume in 16th, 17th, and 18th centuries—Aspects of modern English embroidery—the designs for it: different phases of its practice, for ordinary trading purposes, for more limited purposes, and for special occasions in connection with technical instruction—Embroidery.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

May 15, 22.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Alan S. Cole, "Some Aspects of Ancient and Modern Embroidery." (Lecture I.)

Farmers' Club, 2, Whitehall-court, S.W., 4 p.m. Prof. Wrightson, "The Expenses and Commensurate Advantage of Turnip Cultivation in Southern England."

Royal Institution, Albemarle-street, W., 5 p.m. Annual Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Ernest R. Mathews, "The Parade Extension Works at Bridlington."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Prof. Chiri Otsuki, 1. "The Study of the Action of Hydrogen Peroxide on a Photographic Plate in the Dark." 2. "The Influence of the Length of the Time of Development on the Degree of Darkening of the Photographic Plate."

British Architects, 9, Conduit-street, W., 8 p.m. Annual Meeting.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. Edward P. Frost, "The Influence of Physiological Discovery on Thought,"

TUESDAY, MAY 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Applied Art Section.) Mr. J. Starkie Gardner, "The Monumental Treatment of Bronze."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Study of Extinct Animals." (Lecture II.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Redmond Barrett, "Retouching and Improving the Negative."

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, MAY 3 SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Ordinary Meeting.) Mrs. Burton-Brown, "Recent Excavations in Rome."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. The Viscount Dillon, "The Rack."

British Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, MAY 4...Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Discussion on Mr. A. M. Taylor's paper, "Standby Charges and Motor Load Development."

Linnean, Burlington-house, W., 8 p.m. 1. Mr. A. G. Tansley, "Ecology: its present position and probable development." 2 Mr. R. N. Rudmore Brown, "The Flora of Gough Island."

Chemical, Burlington-house, W., 8 p.m. 1. Mr. H. D. Dakin, "The synthesis of substances allied to adrenaline." 2. Mr. J. Johnston, "Methylation of p-aminobenzoic acid by means of methyl sulphate." 3. Mr. J. M. Wadmore, "Some notes on sodium alum." 4. Messrs. M. O. Forster and H. E. Fierz, "Camphoryl-ψ-semicarbazide."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Sir James Dewar, "Flame." (Lecture I.)

United Service Institution, Whitehall, S.W., 3 p.m. Lieut.-Col. H. A. Iggulden, "The Tibet Expedition."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. J. C. Osborne, "Card-Indexing and Filing."

FRIDAY, MAY 5...Royal Institution, Albemarle-street, W., 9 p.m. Professor H. E. Armstrong, "Problems underlying Nutrition."

Art Workers' Guild, Clifford's-inn Hall Fleet-street, E.C., 8 p.m. Paper on "The Work of Reynolds."

Geologists' Association, University College, W.C., 8 p.m.

Junior Institute of Engineers, Westminster Palace Hotel, S.W., 7 p.m. Mr. Leslie C. Lambert, "The Influence of Depth of Water on Speed of Vessels." Mr. James N. Boot, "Condensing Plant."

Philological, University College, W.C., 8 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, MAY 6...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Marshall Ward, "Moulds and Mouldiness." (Lecture I.)

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FRIDAY, MAY 5, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 8, 8 p.m. (Cantor Lecture.) ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Lecture II.

WEDNESDAY, MAY 10, 8 p.m. (Ordinary Meeting.) VISCOUNT MOUNTMORRES, "The Native Races of the Unknown Heart of Central Africa."

THURSDAY, MAY 11, 4.30 p.m. (Indian Section.) HENRY J. TOZER, M.A., "The Manufactures of Greater Britain.—III. India."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 1st inst., Mr. ALAN COLE, C.B., delivered the first lecture of his Course on "Some Aspects of Ancient and Modern Embroidery."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday afternoon, May 2; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The paper read was "The Monumental Treatment of Bronze," by J. STARKIE GARDNER, F.S.A.

The paper and report of the discussion will be published in the next number of the *Journal*.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 4, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, May 3, 1905; CARMICHAEL THOMAS, Treasurer of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Cato, W. C., Malvern, Augusta-road, Hobart, Tasmania.
Davis, Charles E., 847, North Church-street, Rockford, Illinois, U.S.A.
Parker, Critchley, Broken Hill-chambers, 31, Queen-street, Melbourne, Australia.
Ruffer, Henry, Menival, Crystal Palace Park-road, S.E.
Sheath, James T. T., 87, City-road, E.C.
Sturgess, Archibald T., M.I.Mech.E., Messrs. Sturgess and Foley, Alcala 52, Madrid, Spain.
Thompson, Charles Herbert, F.C.S., Enville-street, Stourbridge.

The following candidates were ballotted for and duly elected members of the Society:—

Ababrelton, Robert à, P.O. Box 322, Pietermaritzburg, Natal, South Africa.
Kinch, Walter S., Burtholme, Worthington, near Wigan.
Lucchesi, Andrea C., 2, Camden Studios, Camden-street, N.W.

The paper read was—

RECENT EXCAVATIONS IN ROME.

By MRS. BURTON-BROWN.

In 1898 Commendatore Boni began to excavate the Roman Forum for the Italian Government. It may be said, without exaggeration, that all the remains of classic Rome which are most full of significance, and which throw the greatest light upon the Romans, upon the development of their religion, their political institutions, and their life, have been revealed

during the seven years of his work there. The Forum was the centre of every side of the life of the City; its most ancient shrines, its place of political assemblage, its judicial tribunals, and its best shops were all situated in the narrow and marshy valley which first rose into importance as the common market-place of the small villages set upon the hills in the midst of which it lay. Through it passed the great triumphal possessions, and in it every class of Romans assembled for social intercourse. The times of the Kings and of the Republic are those in which the foundations of the Roman power were laid, and in the institutions of those times the pure Roman elements which lay at the base of it are to be traced. The centuries of the Empire shew us a Rome in which foreign influences and importations had modified, and in great part changed, the true characteristics of the Roman, and of his religious and political ideals: it is therefore to the remains of kingly and republican Rome that Signor Boni has striven to reach, and striven with a success which has exceeded all expectation.

It would seem that the Latin tribes entered Italy from the north-east corner, and wandered along the low flat coast, about 1000 B.C. At last they crossed the Apennines and again settled, on the western side of the peninsula, rather upon low hills rising out of the marshes than upon lofty mountain peaks. They would seem to have been originally lake-dwellers, and the name Latin has been derived from *latus*, "the people of the plain." From the small volcanic group of the Alban Hills some of them came westwards to the Septimontium, and communities grew up on the Capitol, the Esquiline, the Palatine, the Quirinal, &c., which, about the eighth century B.C., were united into one city by the chieftain of the Palatine, whom we call Romulus. The villagers met for exchange and barter in the valley of the Forum, and so great was the loyalty of the Romans in later times to the traditions of their city, that for a thousand years that valley remained, in spite of all its inconveniences, the central point of its life. The Sacra Via, the famous path of the triumphs, and the road where Horace strolled with his friends, was at first a track across the marsh, passing along its higher and its sunnier side, and uniting the two chief villages of the Palatine and the Quirinal.

All dwellers upon hills must fetch their water from a spring below, or rather they must send their womenkind to fetch it. Under the steep cliff of the Palatine a copious spring rose to the surface, which the Romans called the fountain of Juturna. From it the first Palatine women carried water in rough earthern jars up to the village, as the women of so many little towns in Central Italy do to-day. When the Romans had learned to dig wells for their water the primitive associations of this spring with the origins of the State gave it a peculiar sanctity in their eyes, and it became a shrine of that nature-worship which held their allegiance so much longer, in its purer and more abstract form, than it did that of the Greeks. The Romans had an implicit belief in the curative powers of water, and what water was so likely to be beneficial

FIG. 1.

CLIVUS SACRÆ VIÆ.

as that of the first sacred pool of their forefathers? A sanctuary of healing grew up around the place, which became a kind of pool of Bethesda of the city. Varro derives the name of Juturam from *juvare*, "because so many sick are wont to seek the aid of the waters." A number of small arched cells behind the pool were found to contain the statues of health divinities, and seemed to have formed a kind of open-air hospital.

The story went that Castor and Pollux, appearing from the sky upon white horses, decided the battle of Lake Regillus in favour of the Romans, and afterwards announced this crowning victory over the Tarquins in the Forum, where they washed their horses in the fountain of Juturna. Their statues were set up at the place, and numerous fragments of these have come to light there. The sacred

pool was placed in the charge of a priesthood, and since it was mainly resorted to by women, this was very naturally a female one. Close beside it stood the hut of the public fire from which the same women might fetch embers to rekindle their own hearths, and which was under the care of the same priesthood, the Vestal Virgins. These were "the daughters of the City," and performed for the State all such duties as in each household were performed by its womenkind. They were present at all ceremonies connected with the harvest, they brought the sacred water for expiatory sacrifices, they cooked the sacred cakes of the mola salsa, and they kept alight the fire upon the City Hearth. It was this intimate connection of theirs with the corporate State which gave them so deep and abiding a sacredness to a Roman mind.

The Hut of the Fire was called the "Aedes Vestæ," and since it was above all the shelter of the hearth of the city, it kept throughout its many successive re-buildings the circular form of a primitive hut, such as we see in the clay hut-urns found in early Latin cemeteries. The dwelling of the Vestals adjoined it, and close to both stood the Regia,* "the royal house," and the dwelling-place of the King and Father of the primitive Family State of Rome. Thus it came about that there grew up in the south-eastern corner of the valley, around the spring, a group of shrines closely connected with the earliest beginnings of the joint city.

In the diagonally opposite, and north-western corner, was the Comitium, or place of political assembling. It was railed off by Tullius Hostilius, who built the first Senate House, or Curia, on the slope of the hill above. In the Comitium stood the platform for orators, which was called the "rostra" because it was decorated with prows of the ships taken in naval warfare. In the Comitium, Boni has explored 23 archæological strata, these being floors laid down one upon another, and each one scattered with relics of the pottery and the sacrifices of the Romans. Several passages from Latin writers agree in stating that there was here, and in close connection with the "rostra," a "Lapis Niger," which marked the site of the tomb of Romulus, which tomb was guarded by two lions of stone (or by one). The famous Black Stone was found in 1899 and is actually a trapezoidal piece of black marble pavement let into the white pavement of the Comitium, undoubtedly in order to hide from view certain ancient and ruined monuments which it covers, while for ever commem-

FIG. 2.

THE REGIA (from "Recent Excavations in the Roman Forum.")

* Figs. 2 and 5 from illustrations in Mrs. Burton-Brown's "Recent Excavations in the Roman Forum, 1898-1905," have been kindly lent by the publisher, Mr. John Murray.

orating their position. In order to discover whether a tomb of Romulus did really exist beneath it, Boni dug under the marble, having supported it on iron props. He found there two bases on which the lions may well have stood, together with two broken columns, the one conical, the other pyramidal, in shape. Around them lay the remains of a great sacrifice, and many votive offerings. Boni's own theory is that during the social wars of the Republic, when the plebeians were attempting to seize a share in the government from the patrician families of pure Roman blood, and when their tribunes appropriated the "rostra" for their own demagogic harangues, the patricians made a violent onslaught upon them. The ancient monuments before the platform were broken, but the plebeians performed a great expiation, and covered down the ruin with black marble brought from Cape Matapan.

FIG. 3.

ARCHÆOLOGICAL STRATA IN THE COMITIUM.

The pyramidal column is covered on all four sides by an inscription, written *boustrophedon*, and in Chalcidic Greek; but, in spite of all efforts, only a very general idea of the meaning of this will ever be gathered, since two-thirds of it are broken away.

The period of the Republic has few remains of importance in the Forum which distinctively belong to it, although it is very clear that the notions of the Romans of that most important time in their history, as to religion and as to political aims, are greatly elucidated by the monuments which have just been described. Pavements and mighty drains of Cato and his contemporaries can indeed be pointed out *in situ*, and the latest discovery is one which must not be forgotten. It is the Lacus Curtius. Ovid remarks that in the spot where the gulf opened and closed upon Márcus Curtius, a pavement had in his time been laid down. This pavement, together with two others beneath it has come to light in the centre of the Forum, and upon it is part of the altar where sacrifice was performed to the Manes of Curtius.

Julius Cæsar determined to put an end to the republic, and to establish an autocracy based upon a wide democratic popularity. As he planned to transform the State, so he transformed the Forum. The buildings in it, whether consecrated to religious or to political uses, had been orientiated according to the sun's course, when they were inaugurated by the augurs. Walls and pavements can be seen in every part of the Forum lying below those of the Empire, and set upon these lines. One by one each was rebuilt or changed by Julius Cæsar and by Augustus, and in defiance of the old customs of inauguration the new imperial Forum grew up, a broad open square following the natural conformation of the valley and the Capitol. This Forum was dominated by the new Rostra of Cæsar, from which the orators addressed the mob assembled in the open space, and no longer the free men of the Comitium. It was lined on both sides by the Basilicæ Julia and Æmilia, and at the further end, appropriately enough, stood the temple of Divus Julius, just behind the altar which Augustus erected on the site of the pyre of the great dictator. The people, as they assembled in the Forum, saw it surrounded by monuments of imperial magnificence, and the lofty temple of Julius, together with the triumphal arch of Augustus, shut the primitive shrines of Vesta, Juturna, and the Regia out of sight and out of mind. In order to enhance his popularity, Julius determined to hold the games on a scale of greater splendour than before. It was difficult, as may well be imagined, to find room for this, and it is now found that he tunnelled its length and breadth by a system of five subterranean corridors. By means of these, theatrical properties, fighters, and wild beasts were brought beneath the arena, and were hauled up to it by small lifts. There are ample traces of the windlasses by which these were worked. The

FIG. 4.

INSCRIPTION ON THE PILLAR UNDER THE BLACK STONE.

FIG. 5.

ROSTRA OF CÆSAR (from "Recent Excavations in the Roman Forum").

corridors when found were quite choked with earth and rubbish, and now that they have been cleared they are the most salient proof which could be found of Cæsar's political aims.

Statius tells us that a colossal bronze equestrian statue of Domitian was set up under that emperor in the midst of the Forum. Its concrete base was discovered recently. On searching it Boni found a block of travertine embedded in the concrete. A small hole in the middle of it contained six vases of a very primitive type, a type indeed which was in use as we have every reason to believe about the eighth century B.C. Their contents comprised some gold ore. We know that Vespasian in laying the foundation-stone of the temple of Jupiter placed in it unsmelted precious metals, and there can be little doubt that we have here the remains of the inaugural votive offering of Domitian's monument, contained in what the Romans called "Vasa Numæ," *i.e.*, vases made in imitation of those actually in use under the King, whom they revered as the founder of the religious institutions of the city.

Outside the Forum a most beautiful monument of Augustus has recently been partially explored by Signor Pasqui, the "Ara Pacis Augustæ." It was dedicated in the year 9 B.C. by the Senate, in commemoration of the victories of Augustus, and of the opening of that golden age of Peace which it was hoped that they might bring to the Roman world. It consisted of an altar of sacrifice raised on a platform, and surrounded by a marble enclosure wall covered with carvings in relief, both on the inner and the outer side. A large number of slabs from this wall have long been at the Villa Medici, others in the Vatican, the Uffizi, and the Terme Museum. Only recently, however, has it been recognised that they were connected, and that they belonged to the Ara Pacis, and in consequence, Pasqui was entrusted with the further exploration of the site from which they came. Many more fragments have come to light as well as the plinth of the wall.

The outer face of the screen had a frieze which represented a procession of majestic and dignified Romans, led by the Emperor Augustus, to do sacrifice at a shrine. They comprise four Flamines and other priests, as well as the ladies of the Imperial Family, and portrait figures of Tiberius, Drusus, and others. The sacrifice is offered by a symbolical figure representing the "Senatus Romanus," at a rustic stone altar. The shrine is shown as that of a graceful reclining woman surrounded by the emblems of fertility. She has been usually explained as "Tellus," but may equally well represent Augustan Peace, surrounded by the accompaniments of Fruitful Earth. The frieze may be regarded as the marble counterpart of the Carmen Seculare, which is filled with rejoicing over the prosperity which was expected as the result of Augustus's rule. This processional frieze challenges comparison with that of the Parthenon, and in the contrast between them lies the difference between the ideals of Greek and Roman. Upon the Parthenon all dignity and majesty is concentrated in the figures of the "Deathless Gods," the people are full of lighthearted gaiety, and not one of them is individually characterised. The true religion of the Romans was their loyalty to the State and its officials; hence upon the Roman frieze the dignity and clearly marked personality of the latter is the first quality which strikes the spectator, and the figure of the worshipped is marked by a merely symbolic grace. Augustus knew how to use every Roman feeling of devotion to early political and religious traditions as yet one further aid to his own greatness. He called himself Tribune of the Plebs for life, and associated himself with the institution of the Flamines as well as with that nature-worship, which, as we have seen, had always had so strong a hold on the devotion of the Roman mind. Where Julius had openly grasped at absolutism and had fallen, Augustus built up his power by diplomacy and succeeded.

DISCUSSION.

The CHAIRMAN said it was only occasionally that the members of the Society had the opportunity and pleasure of hearing a paper read by a lady; and he was sure everyone present would agree with him that the presence of Mrs. Burton-Brown had been very welcome, and that they had listened to her admirable paper with very great appreciation. There must be many members whose professional and business duties prevented them visiting the interesting places of the world; and on looking at the wonderful photographs which had been shown he could not help feeling what a great debt everyone owed to the great improvements that had been made in photography during the last 20 years by means of which the treasures of the world had been brought to their very door; in fact, there were comparatively few places of great interest which were not to a certain extent known, thanks to those good-natured people, like the

authoress, who wandered about the world with their eyes open for any artistic possibilities, with camera ready to be touched, and with the pocket-book handy in which to take down notes. Although great artistic institutions sent their promising students to Rome, it was on the camera that the majority of students must rely if they wished to increase their artistic knowledge by constant reference to the antique. The thoughts of every student turned to Rome, and it was not surprising that it should be so when one looked at the beautiful specimens of architecture and sculpture that were constantly being shown on the well-known screen of the Society. Only the previous day, Mr. Starkie Gardner gave a most interesting lecture at the Society on Bronze, and there again the finest work was Italian; in fact, which ever way they turned, if the papers were in any way connected with art, the screen was bound to have some representation of Roman art upon it. It was not only in art matters, however, but in other subjects that Roman influence predominated. For instance, he noticed in the paper Mrs. Burton-Brown mentioned that in the arena the wild beasts were taken up to the performance by lifts, in the same way that similar performances were conducted at the Hippodrome or the Coliseum at the present day. An open-air hospital had also been mentioned, which made one believe that perhaps the modern cure for diseases of the lungs was not so very modern after all.

Prof. Flinders Petrie, F.R.S., stated he had come to the meeting with the hope of getting a clearer crystallisation of ideas in regard to the discoveries which had been made during recent years in the Forum, and he had been amply rewarded. He would only say how glad all the members were to have the various discoveries so well oriented and put together in order that they might grasp them more clearly and see their meaning more distinctly, thus being better prepared for looking over the ground the next time they passed through Rome.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mrs. Burton-Brown for her interesting paper, which Mrs. Burton-Brown briefly acknowledged, and the meeting terminated.

LARGE IRRIGATION SCHEME FOR THE PUNJAB.

The Government of India has just published the report of the Chief Engineer, Mr. J. Benton, C.I.E., on the Project Estimates of the Upper Jhelum, Upper Chenab, and Lower Bari Doab Canals, the construction of which has been recently authorised. The entire scheme is one of considerable importance and magnitude, involving an expenditure of Rs.7,82,38,925 (approximately, £5,216,000). Of the three canals, the Upper Jhelum Canal is to irrigate portions of the Upper Jech Doab, and convey the surplus water of the Jhelum to the Chenab River, tailing in above the head works of the existing Chenab Canal. The Upper Chenab Canal, is to commence opposite Sialkot, and to draw off as much water as is tailed in by the Upper Jhelum Canal, is to proceed through Gujranwala to the Ravi, irrigating portions of the Upper Rechni Doab. The Lower Bari Doab Canal, is to start from the end of the Upper Chenab Canal and to irrigate the Lower Bari Doab tract. The following Table gives the leading particulars concerning the cold weather supply in the Punjab rivers:—

1. *River Indus.*—Wholly unutilised at present. Surplus cold weather supply in cusecs, 9,434 (minimum). Tracts to be served with cold weather supply—(i.) Sind Sagar Thal. (ii.) Sidhnai Canal. (iii.) Chenab series of canals, Mooltan district.
2. *River Jhelum.*—Lower Jhelum Canal. Balance wasted at present. After setting aside 2,000 cusecs for the Lower Jhelum, the average amount of surplus water throughout the cold weather will be from 5,651 to 7,946 cusecs in dry and ordinary years respectively. Tracts to be served with surplus cold weather supply—(i.) Upper Jech Doab, by proposed Upper Jhelum Canal. (ii.) Upper Rechna Doab, by proposed Upper Chenab Canal. (iii.) Lower Bari Doab, by proposed Lower Bari Doab Canal.
3. *River Chenab.*—All utilised by existing Lower Chenab Canal. Surplus cold weather supply, nil.
4. *River Ravi.*—All utilised by existing Upper Bari Doab and by Sidhnai Canals. Surplus cold weather supply, nil.
5. *River Beas.*—Wholly unutilised. Flows into the Sutlej at Hariki. Surplus cold weather supply in cusecs, 4,000 (minimum).
6. *River Sutlej.*—Wholly utilised at off-take of Sirhind Canal at Rupar. No surplus water, but receives a supply at the confluence of the Beas of 4,000 cusecs. Beas River to be wholly used for Sutlej Valley, riverain tracts, and high land on each side.
7. *River Jumna.*—Wholly utilised by Eastern and Western Jumna Canals. Surplus cold weather supply, nil.

Considerable attention was given during the period of drafting the scheme to the question of a sufficiency of water for irrigation during the cold weather. From observations of the available supply which had been collected during the preceding fourteen years, it was found that in ordinary years, which occur twice in four years, there was a satisfactory surplus. In favourable years (occurring once in four) a larger margin, in dry years a bare margin, while in extraordinarily dry years there would be a deficiency of 11 per cent., an amount which occasionally occurs with existing canals. In this connection the con

version of the Woolar Lake into a great reservoir for the storage of flood water has been mooted. As an additional supply is only required at rare intervals, the consideration of this project is for the present postponed.

The following are the leading particulars concerning the three canals:—

Particulars.	Canal.		
	Upper Jhelum.	Upper Chenab.	Lower Bari Doab.
Length of Main Line (miles)	88	99	43
Length of Branches (miles)	48	113	113
Length of Distributaries (miles)	562	1,092	1,060
Discharge at Head of Main Line (cusecs)	8,500	11,694	6,481
Annual Irrigation (acres)	344,960	648,367	882,528
Annual Gross Revenue, Direct and Indirect (rupees)	18,35,040	32,14,789	45,32,640
Annual Nett Revenue, Direct and Indirect (rupees)	13,60,720	25,66,422	38,70,744

In order to popularise the speedy development of irrigation, Mr. Benton suggests that on all old village lands water should be supplied free for one crop, and at half rates for the next. Such a procedure would hasten the extension of irrigation by facilitating the rapid construction of watercourses through privately-owned lands, a work of much importance, liable to be delayed if great inducements are not offered.

The annual amount of land to be irrigated by these canals is estimated to be 1,875,855 acres, while it is highly probable that this will exceed 2,000,000 acres as the works become fully developed. Several very important reasons are given for the sanctioning of this important project. Among these may be cited several which are also common to all irrigation schemes, and which unhappily represent the state of affairs in many districts where irrigation is impossible. On their completion famines will for ever cease in the Gujrat district, which will be irrigated by the Upper Jhelum Canal; the dense population of the Upper Rechna Doab, to be irrigated by the Upper Chenab Canal, will find their circumstances greatly improved; while the Sharakpur Tahail of the Lahore district will become as prosperous as the Chanab Canal Colonies, and the great unfructuous dry jungle wastes of the Lower Bari Doab, to be irrigated by the Lower Bari Doab Canal, will become one of the richest and most fruitful in the province. In addition, the widespread failure of crops dependent on rainfall in Gujrat, Shahpur, Gujranwala, Lahore, Montgomery, and Mooltan districts, may be expected to practically cease for those portions of these districts which lie within the tracts commanded by the proposed works.

Quite apart from these important humanitarian considerations, the available food produce of the country will be greatly increased, with the result that Government railway receipts, which always benefit by irrigation works, will be greatly increased. Part of the Lower Bari Doab will be available for colonisation, and thus relieve the congestion in certain other districts, and at the same time afford the Government the opportunity of rewarding many of its deserving servants. Industrially, also, great developments are certain to accompany the rise of a prosperous agricultural population. Provision is made in the scheme for the construction of 21 flour mills, containing 270 stones; these are estimated to cost 459,000 rupees, and to yield a nett annual revenue of 1,12,800 rupees. There are two falls, over 30 feet, at the head of the Gujrat branch, and one at the tail 11 feet, which might be used for generating electric energy for transmission elsewhere.

Allowing for the enhanced land revenue which will be obtainable, the three projects will yield a handsome net profit of about Rs.50,00,000 annually after defraying working expenses and meeting interest charges. Apart, however, from the fact that this large scheme offers a financial profit, there will be none who can honestly controvert Mr. Benton's claim that "Government, by executing these works, will make a great, an everlasting, and a praiseworthy advance in its beneficent administration of the country."

GERMAN TRADE.

Mr. Consul-General Schwabach's report on the trade of Germany for 1904 (No. 3.333 Annual Series) affords abundant evidence of the continual expansion of the industrial enterprise of the Empire. Whilst 1904 cannot be described as an exceptionally good year, the condition of German trade and industry was, perhaps, the Consul-General thinks, "better on the whole than that of any other European country." A significant feature of the trade returns is the evidence they afford of the increasing importance of the export trade in machinery and highly-finished iron goods, testifying, as it does, to the unremitting and successful efforts of the German manufacturer to turn out good work at moderate prices, in fact, at lower prices than his competitors. The iron industry, the manufacture of machinery and instruments, and the electrical and chemical industries, at present form the centre of industrial life in Germany. But the great expansion of the iron works necessitated either an enormous increase in the inland demand, or an extension of the export trade if the works were to be fully or even moderately employed. With but a slowly increasing inland demand, and a greatly reduced export trade, the record production of 10,086,000 metric tons of pig iron in 1903 was only just maintained in 1904, and the increase in the output of coke, and also, to a considerable degree, of coal, was smaller than in the two preceding years. Although

the iron and steel works, after completion of the extensions and improvements had been decided upon during the period of great expansion, are capable of a much higher production than they are likely to dispose of for some years to come, the existing iron works are, says the Consul-General, being constantly augmented by the erection of new furnaces and the carrying out of extensive improvements and modernisations. "The policy of expansions for which there is no present need, would seem to indicate great confidence in the possibilities of the industry, possibilities which must be looked for primarily in the export trade, as the inland market, though capable of improvement, is of limited extent. Great attention is paid to reducing the cost of production to a minimum, and manufacturers constantly urge the revision of the goods tariff of the German railways, and the construction of new waterways, in order to lessen the cost of transport. There is also a growing tendency to make each iron and steel works as complete as possible, and practically independent as regards raw materials, and so further concentrate within single works the whole process of production from the smelting of the iron to the finished article."

A Table dealing with the motor-car industry is deserving of attention. The export of motor cars from Germany more than doubled within the last year. The total exports of automobiles in metric tons in 1902 amounted to 527, in 1903 to 588, and in 1904 to 1,309. Of this export 299 tons were exported to the United Kingdom in addition to 235 under the head of "other motor vehicles," 434 to France, 221 to Austria-Hungary, and the rest to various other continental countries. On the other hand Germany imported 846 metric tons of automobiles, and 59 of "other motor vehicles." Of the former almost 75 per cent. were imported from France, and only 19 tons from the United Kingdom; of the latter description 50 tons were imported from the United Kingdom.

In Germany, as elsewhere, the growing demand for industrial labour is thinning the country side. Urban life offers strong inducements to the rural population in the form of higher wages, greater independence, often better housing and treatment, and greater facilities for amusement. The hope that the agricultural labour bureaux, which were considerably extended a few years ago, and systematically connected with labour industrial bureaux, would benefit agriculture by facilitating the exchange of industrial hands has not been fulfilled. "In the year of depression," writes the Consul-General (1901-02), "they no doubt helped to draft a part of the surplus population back to the country, but they proved powerless at the first symptoms of returning industrial activity. Farmers, are, of course, greatly agitated by this state of affairs, and, since they cannot compete on equal terms with the manufacturing industries, they openly advocate the repeal, or at least restriction, of the "Freizugigkeit" or liberty of movement of the agricultural population in order to secure an adequate supply of agricultural labour." The great and ever-increasing dearth of agricultural labourers, particularly in Eastern Germany, makes it necessary to prevent as far as possible the hitherto frequent breach of contracts on their part. With this object a Bill has been laid before the Prussian Diet imposing heavy penalties on agricultural labourers and farm hands for breach of contract. It stipulates, *inter alia*, that whoever engages labourers, farm hands, or servants whom he knows, or might have known to be under contract of service with another employer, shall be liable to a fine of £7 10s., or a corresponding period of imprisonment, and a similar penalty applies to agents, middlemen, or others who induce or persuade farm labourers or servants to quit service n contravention of their agreements, or who assist them to take service elsewhere while still bound by contract.

AUSTRALIAN BUTTER AND CHEESE.*

Although small experimental shipments of Australian butter had been made to London, at intervals, during the last forty years, mostly in air-tight cases, it was only recently that the possibilities of its forming a regular article of export became apparent. Much of the experimental butter was found equal in appearance, flavour and quality to the finest imported from Normandy, from which it could not be distinguished when packed in the French manner. But the comparatively high prices, occasioned by the heavy cost of freight, and the almost total absence of cold storage accommodation on both steam and sailing vessels, proved an almost insuperable obstacle. As these difficulties became surmounted, and it was found possible to place Australian butter on the British market at fairly remunerative prices, the dairy farming industry began to expand rapidly in New South Wales and Victoria, and, subsequently, in Queensland, in which there are extensive areas, embracing a total of several thousand square miles, admirably adapted for dairying purposes. At the end of 1903 the estimated number of dairy cows in the Commonwealth was 1,270,706, of which all, save 115,108, are found in the three States above mentioned. The estimated quantity of milk produced was 343,909,000 gallons, the total value of the milk, butter, and cheese obtained being £5,547,000. The quantity of butter obtained in 1903 was 100,678,000 lbs., Victoria leading the way with 46,686,000 lbs., and New South Wales following with 38,727,000. The cheese production amounted to 13,659,000 lbs., of which Victoria's share was 5,682,000 lbs., and that of New South Wales 4,748,000 lbs. The surplus production available for export, after supplying local requirements, was: butter, 38,675,258 lbs.; and cheese, 1,920,914 lbs.

* Communicated by Mr. John Plummer, Sydney, New South Wales.

In 1904 the production of butter became enormously increased, and it is anticipated that the advance will be maintained in 1905, especially in Queensland, where a considerable portion of the coastal belt possesses a rich soil, with a fairly copious rainfall, while the climatic conditions are apparently favourable to the production of large quantities of milk. Considerable portions of the inland districts are also being utilised for dairy farming purposes, the monthly payments for milk supplies at Warwick alone reaching a total of £1,500. In New South Wales the exports of butter have risen from 284,257 lbs. in 1889, to 7,461,575 lbs. in 1903; in Victoria, from 505,478 lbs. in 1889, to 15,908,342 lbs. in 1903; in Queensland, from 1,064 lbs. in 1893, to 951,501 lbs. in 1903; and in South Australia, from 10,050 lbs. in 1890, to 453,656 lbs. in 1903. In 1900 New South Wales exported 8,477,617 lbs.; Victoria, 26,185,679 lbs.; while in 1894 the South Australian figures were 1,233,539 lbs. These were favourable years. In New South Wales the coastal districts south and north of Sydney are among the finest in existence, the bulk of the milk consumed in the State being obtained from the Illawarra region, where the pasturage is of a most luxuriant character, especially in the country watered by the Shoalhaven River, the rich alluvial flats on either side of the stream being studded with plump, sleek dairy cattle, which any British or other gentleman farmer would be proud of possessing. Neither France nor Denmark can produce butter of a finer quality than that made in this part of the Commonwealth. Victoria is fortunate in the possession of rich natural pastures, which, as in portions of the other States, renders unnecessary much of the artificial feeding indispensable in colder countries. A considerable portion of the butter and cheese production is based on the co-operative system. The dairy farmers supply the creameries and butter factories with milk on certain terms periodically arranged, the payments being in accordance with the quality of the milk. They also participate in the profits obtained from the sale of the butter and cheese. The skim milk is used for feeding pigs. The number of butter and cheese factories in Victoria in 1903 was 207; there were also 281 creameries, the total number of hands employed being 1,319, and the value of the buildings, machinery, plant, &c., £524,448. In New South Wales there were 125 butter factories and 97 creameries, employing 951 hands, the value of the machinery, plant, &c., exclusive of land, buildings, &c., being £182,567. With the opening up of fresh country by means of railway and other means of communication, and the subdivision of extensive areas alienated in bygone years and now required for closer settlement, a further expansion, on a most extensive scale, is inevitable. A gcod dairy farm in experienced and industrious hands is said to be a surer source of competence, if not wealth, than would be the possession of a rich gold mine.

STATISTICS OF THE FEDERATED MALAY STATES.

There was published in the autumn of 1904, at Kwala Lumpur, the capital of the Federated Malay States, a Blue-book entitled "Manual of Statistics Relating to the Federated Malay States." Its compiler, Mr. A. R. Venning, the Federal Secretary of the Federated Malay States, explains in the introduction that "The publication of a Blue-book for the Federated Malay States in the form adopted by the Colonial Office for use in British Colonies has not hitherto been found practicable under existing conditions; but, at the same time, there is ample evidence of a demand for statistics to show the position of these States in respect of such matters as Population, Financial Prosperity, Trade, Customs Duties, Railway Construction, &c." To meet this demand, this Blue-book, printed at the Government printing office, has been prepared. It gives a complete list of all taxes, duties, fees, &c., in connection with mines, forests, harbours, and other sources of wealth, or branches of industry which lend themselves to taxation. Particulars are also given of the revenue and expenditure of Perak, Selangor, Negri, Sembilan and Pahang; since 1875, in the case of the first three, and since 1889 in the case of the State last mentioned. The amount of revenue collected under various heads is recounted, nearly one-half being obtained in the shape of an export duty on tin. The Federated Malay States possesses a Public Works Department, which has done a great deal towards the development of the country. During the past five years 3,731,508 dols. have been expended on the construction of roads, streets, and bridges. As regards the mileage of roads, there have been constructed and maintained 1,079 miles of metalled cart roads, 400 miles of other cart roads, and 683 miles of bridle paths. The capital expenditure on some 340 miles of railway open for traffic amounted, on December 31st last, to 31,060,657 dols.

As regards area and population, the gross area of the four States amounts to 26,380 squaie miles, of which 523,408 acres are alienated under permanent title for agricultural, and 290,002 acres for mining purposes. Forest reserves of a total area of 242,816 acres have been provided. The bulk of the agricultural land is given to rice cultivation, 125,811 acres being under this crop. Cocoanuts are grown on 74,650 acres, tapioca on 39,731 acres. Rubber is cultivated on 24,551 acres, coffee on 22,701, and sugar on 17,729 acres. Some 25 acres have been planted with cotton. The total population at the time of the last census amounted to 678,595 persons, of whom 1,422 were Europeans or Americans, 1,532 were Eurasians, 299,739 Chinese, 312,486 Malays and miscellaneous aboriginal inhabitants of the Malay Archipelago, 58,211 Tamils and other Indians, and 2,582 other races. Of the Chinese population, 6,056 are Straits born, and 27,155, or, practically, 1 in 11, are females.

Import and export trade returns are given, the former in 1903 being slightly under 48,000,000 dols., and the latter slightly over 80,000,000 dols. Of individual items of import, live animals, food, drink, and narcotics account for rather less than two-thirds, or 30,112,685 dols., manufactured articles of 6,933,748 dols., and bullion and specie for 6,362,772 dols. The chief item in the export returns is that of 73,500,000 dols. for raw materials, consisting mainly of tin and tin ore. In connection with this latter, several columns of figures are given of the weight of tin and tin ore exported, but an enumeration of the values is lacking.

This interesting review closes with some meteorological tables, and a note on the chief features of the meteorology of the Federated Malay States by Mr. A. E. Young. It appears that "the climate of the Federated Malay States is very uniform, and can be described in general terms as hot and moist. The annual rainfall, except in places close to the mountain ranges, is about 90 inches. In towns such as Taiping, Tapah, Selama, &c., close to high mountains, upwards of 50 per cent. more is registered, the average of ten years' record at the first-named being 164 inches. There is no well-marked dry season. Generally speaking, July is the driest month, but has seldom anywhere a less rainfall than 3½ inches. The wettest season is from October to December, and there is another wet season of slightly less degree during March and April. Rain rarely falls before 11 a.m., so that six hours of out-door work can generally be depended upon all the year round.

"The average maximum temperature occurring between noon and 3 p.m., is in low country just under 90 deg., and the average minimum occurring just before sunrise is just over 70 deg. The general mean temperature is just about 80 deg. There is very little change in the mean monthly temperature during the year, the average of ten years' readings in Taiping exhibiting a difference of only 3·2 deg. between the mean temperature of May, the hottest, and of December, the coldest, month of the year."

SISAL PRODUCTION IN THE PHILIPPINES.

Maguey or sisal fibre has a variety of uses in nearly all civilised countries of the world. In the United States it is used principally for binder twine, also for ships' ropes and cables and for small cordage. In Mexico and South America it is employed in the manufacture of lines, nets, hammocks and saddle cloths. In European countries it is used for various classes of cordage. The active efforts of cordage manufacturers to obtain suitable material to supply the growing demand for fibre have greatly increased the interest of producers in the development of sisal production in various parts of the world. According to a recent report by the fibre expert of the Philippine Bureau of Agriculture, there is reason to believe that the production of maguey or sisal can be made one of the most important industries of the Philippine Islands. The plant is already widely distributed, having been reported from twenty-two different provinces of the islands, and the output has grown to such an extent that beginning with June, 1904, separate mention of the amount exported is to be made in the monthly trade bulletin issued by the Bureau of Insular Affairs. Most of the fibre at present imported into the United States is produced in Mexico and Central America. There is a good demand for it, the current quotations in the New York markets usually being but about two cents less per pound for sisal than for the Manilla hemp. In the Phillippine Islands there are large areas of land suitable in every way for the cultivation of this crop, and efforts are being made to improve the conditions of plantation management and to encourage the introduction of modern fibre extracting machinery. Maguey was first introduced into the Philippine Islands from Mexico or Central America by the Spaniards. The plant has long been grown in a small way, but it is only in very recent years since there has been an increased demand for the fibre, that its cultivation has become an important industry. From the provinces of Ilocos Norte, Ilocos Sur, and Union, maguey fibre is now exported in large quantities. The plant is found in many other provinces, and in numerous instances the fibre is extracted for local uses. The production of abaca, or Manilla hemp fibre, has been such an important industry in the islands, and its cultivation has received so much attention that the good qualities and true value of maguey have been, to some extent, overlooked. Ilocos Norte and Ilocos Sur are the two important maguey producing provinces of the islands. Nearly all the fibre exported comes from these two provinces, the plant being found in all districts. In the pueblo of Batac, it is estimated that one-fourth of the population is engaged in producing maguey. In Paoay it is stated that there are 750 acres of maguey under cultivation. It is the general custom on plantations to use the rich lowlands for rice and corn, reserving for maguey, sandy knolls, and any waste lands, it being considered that the only requirement for maguey is sufficient room in which to grow. There has been a great increase in the area devoted to the cultivation of maguey in Ilocos Norte during the past few years, owing to the higher price paid for the fibre. The province of Ilocos Sur produces by far the largest amount of maguey fibre of any province in the islands. The plant consists of a heavy short stem which bears an aloe-like cluster, or rosette, of from twenty to forty thick fleshy leaves. These leaves are from three to seven feet long, and from two to four inches wide. They are light green in colour, are covered with a whitish powdery substance, bear sharp lateral teeth and a terminal spine. The leaf is composed of pulpy material interspersed with vascular bundles which furnish the fibre. When the plant

matures, which is in from seven to fifteen years, a central stalk or pole grows to the height of from fifteen to twenty feet. This stalk first bears flowers, and afterwards a large number of small bulbs, which, when mature, fall to the ground. After flowering once the plant dies. The fibre of the maguey, belonging to the class known as structural fibres, it produced by the leaves. I is obtained by separating the pulpy portion of th leaf from the fine filaments, or fibro-vascular bundles which run along this pulp. The fibre, if carefully separated and dried, is quite white and brilliant. It is four or five feet long, is fine and soft, and is more wavy or fluffy than Manila hemp. Another market quality is its great elasticity. It is said that its main faults are its stiffness, shortness, and thinness of wall, of the individual fibres, and a liability to rot. With reference to the relative tensile strength of the two fibres, it is claimed that Manila hemp spun into a single-strand twine, 650 feet to the pound, should show a tensile strength of 85 pounds for the breaking strain of the weakest portion, while sisal running 500 feet to the pound will show a tension of 50 pounds at breaking strain of the weakest part. Almost any tropical or sub-tropical climate appears to be favourable to the growth of maguey. Owing to its long, fleshy leaves, it will not suffer during a prolonged drought, while it also flourishes in the humid climate and during the rainy season of he Philippines. It is stated that in a humid climates a longer and more elastic fibre is produced. The only injury which the plant suffers in the Philippine Islands from climatic conditions is from the strong winds whieh sometimes tear and lacerate the leaves. There are several methods used in the Philippine Islands for extracting the fibre :—(1) The abaca stripping process; (2) the split bamboo stripping process; (3) the piña scraping process; and (4), the maceration and retting process. The methods of extracting by which the fibre is separated from the pulp without the use of water for retting give a product of very superior quality. These methods, however, are slow and laborious, and are not in any general use. The retting process has for its object the dissolution of the gummy, resinous substance which envelopes the filaments. This substance being very adhesive prevents the free separation of the fibres. If the leaf is not sufficiently rolled, the fibres will still adhere to each other, while if the process is carried too far, the product is seriously injured or rendered utterly worthless. Two distinct methods are in use. In one, the leaves are cut, crushed or beaten, gathered in bundles, and allowed to ferment. When fermentation has ceased the bundles are placed in water until the pulpy material has further deteriorated. By this process one-third or more of the product is converted into tow. By the other method, after the leaves are cut and the thorns removed, they are split in four or five pieces and made into bundles, these bundles being immediately placed in the water for retting. Much depends upon the water used for retting; salt water is preferable to fresh. The tide waters of rivers are most generally used. When the retting process i complete the fibre is removed from the water and dried in the sun. This drying ordinarily requires from two or three days, care being taken that the fibre is not exposed to rain or heavy dews during the drying process as these will injure its appearance. After being thoroughly dried a shaking and brushing is necessary to remove whatever extraneous matter may still adhere to the fibre. The finished product is now ready for baling. During whatever process is necessary care is always taken that the fibre is kept dry, and that the different strands and hanks do not become tangled and dirty. The use of fibre-extracting machines is a question which has received much attention, and is a matter of general interest in the Philippine Islands. In the case of abaca no machine has been introduced which has met with any considerable degree of success. With maguey, however, several different machines are in use in Mexico, the West Indies and Hawaii. There appears to be no reason why such machinery should not be in use in the Philippines. The quantity of fibre produced is amply sufficient to justify its introduction. With suitable climate and soil conditions it only requires machinery to make the production of maguey an important industry in these islands. Maguey or sisal fibre has a recognised place as one of the leading commercial fibres of the world. Its production on a large scale has proved to be a profitable industry in Mexico and Central America, where conditions are in no way more favourable than conditions in the Philippines. With the same business-like management of plantations, and the use of fibre-extracting machinery, the industry, according to the Philippine Bureau of Agriculture, is one which should yield reasonable profits and which is worthy of being widely extended in the islands. Maguey plantations constitute a safe and profitable industry, and where abaca will die for want of water, and cotton is destroyed by insect enemies, maguey continues to flourish and to yield good returns.

ALCOHOLIC BEVERAGES.

A very interesting memorandum has recently been presented to Parliament showing the production and consumption of alcoholic beverages in the various countries of Europe, in the United States, and in the principal British colonies. On page 26 there is a statement showing the part played by the revenue derived from these beverages in governmental finance. Nowhere do taxes on them contribute so large a part of the total national revenue as in the United Kingdom, where the proportion is 32 per cent. The United States comes next with 29 per cent.; then come the Dominion of Canada and Holland with 19 per cent., France and Belgium following with 18 per cent. The percentage for Germany is not worked out owing to the revenue from beer being

raised by the States in several portions of the Empire. Passing to particulars, and beginning with beer, the United Kigdom ranks after Germany as the greatest producer. In 1903 the German production was 1,516,944,000 gallons, as against 1,279,367,000 gallons for the United Kingdom. In the 14 years 1890-1903, that is, during the completed years in which the standard gravity remained unchanged, the consumption of beer per head of population in this country was lowest (29·5 gallons) in 1894, from which point it rose yearly until in 1889 it reached 32·6 gallons. Since then it has steadily declined, and in 1903 amounted to 29·7 gallons. The fluctuations correspond fairly closely with the changes in industrial prosperity. The figure last given is higher than that of any country included in the tables except Belgium, where the consumption per head increased from 38·5 gallons in 1889 to 48·2 in 1900. In Germany it has ranged from 23·2 gallons in 1891 to 27·5 gallons in 1899 and 1900. But the figures apply to the whole of Germany. In 1899, when the maximum consumption per head was reached, it amounted to 37·8 gallons in Baden, 42·2 gallons in Wurtemburg, and 54·6 gallons in Bavaria. Among the principal British colonies, Western Australia takes the lead with a consumption per head not far below that of the United Kingdom. In Canada it is about 5 gallons per head, and in Newfoundland insignificant.

More spirits are produced in Germany than in any other country, but Russia produces almost as much. The substances used for distillation vary greatly. In Russia spirits are distilled chiefly from potatoes and rye; in Germany from potatoes; in the United States from maize; in France from beetroots and molasses; in the United Kingdom from malt. The greatest consumption per head is attained in Denmark, where it is more than three times as great as in this country, and the lowest probably in Portugal. Taking 1903, the Tables show that the consumption of spirits per head of population in Denmark was 3·07 gallons of proof spirit, the Australian Commonwealth coming next with 3·01 gallons, then Germany and Hungary with 1·76, Holland with 1·72, Sweden with 1·65, and France with 1·56. The United Kingdom had only 0·99 in 1903. In the United States the consumption per head was greater than in this country in 1889-93, but less in 1894-99. In 1900 to 1902 it was again greater, having increased whilst the consumption in the United Kingdom diminished. The consumption of spirits, as of beer, has followed nearly the same course, namely that of of general industrial prosperity.

Just as Bavaria heads the list for consumption of beer, and Denmark of spirits, so France produces and drinks the most wine. Practically no wine is produced in the United Kingdom, and not very much in the Empire, the Cape of Good Hope and the Commonwealth producing between them 11,741,000 gallons in 1903, and the rest of the Empire nothing worth speaking about. During the period when the French vineyards were ravaged by the phylloxera, Italy had, in certain years, a greater output, but since 1899, when there was a practical failure of the crop in both countries, the phylloxera has, to a large extent, been stamped out in France, and in many districts the vineyards have been replanted with hardy American vine roots, on which the more delicate French vines have been grafted. In 1898, and again in 1902, the Italian output was greater than the French, but in 1903 the French was 779,000,000 gallons as against 772,000,000 gallons in Italy. The consumption of wine within the British Empire is relatively small. It is the highest in the Cape, where it reaches two or three gallons per head per annum, though exact figures are wanting for recent years. In the United Kingdom the average of the last five years is only 0·37 gallons per head, and it shows no tendency to increase—rather the contrary. The average consumption per head of population in France, taking the five years 1899–1903, was 23·0 gallons, in Italy 18·2, in Spain 19·4, in Portugal 17·0, in Switzerland 15·2, in Bulgaria 15·0; then comes Roumania dropping to 7·08. Austria-Hungary to 3·1, and Germany to 1·4. The consumption per head of the United Kingdom is almost the same as that of Holland and the United States, and, as in Holland, is entirely derived from imports, whilst the greater part of the small consumption of the United States is of home production. Rather more than one-third of the wine intended for consumption in the United Kingdom is derived from France, about a quarter from Spain, and nearly a quarter from Portugal.

EDUCATION FOR THE CONSULAR SERVICE IN AUSTRIA.

An institution, entitled the Vienna Consular Academy, has been founded in that city for the sole purpose of educating young men for the Consular Service of Austria-Hungary. The pupils receive the same general instruction, the exception being in languages which are divided into Oriental and Occidental departments. Pupils who desire to become consuls in the Near East are placed in the Oriental department, where they receive a thorough training in the Turkish language principally, and in the Arabian and Persian tongues secondarily. Instruction has been given in the Chinese language also during the last two years. According to the American Consul at Eibenstock, the conditions of admission are as follows:—(*a*) Austrian or Hungarian citizenship; (*b*) completion of the prescribed course of study in an Austrian or Hungarian gymnasium; (*c*) knowledge of the French and German languages; (*d*) candidates coming from Hungary must have a good knowledge of the Hungarian language; (*e*) knowledge of any other language by the candidates should be noted in his application. The entrance examinations cover the following subjects:—Oral

examination—(1) General history, from the treaty of Westphalia to the Congress of Berlin in 1878, with special attention to the history of Austria-Hungary; (2) the French language; (3) for Hungarian subjects, the Hungarian language. Written examination—(1) A thesis in the German language upon some given subject; (2) a translation exercise from German into French; (3) the same from French into German. The decision as to candidates to be admitted rests with the Austro-Hungarian Foreign Office. Upon entrance, the pupil is placed in the department best suited to the needs of the service and his inclinations. The course of study covers a period of five years. The subjects taught are as follows:—Political economy, commercial politics, science of finance, materials of commerce, commercial geography, elements of jurisprudence, constitutional law, international law, history of diplomacy, military geography, French, English, Italian, Hungarian, Turkish, Arabian, Persian, German, Russian, and Chinese. Thorough training is also given in gymnastics, dancing, fencing, riding, and swimming. The Government has provided for twenty-five State grants, which permit as many students to attend the Academy at Government expense for a period of five years. Ten of these grants amount to £140 each, and fifteen to £110 each per annum. It is possible for a student in the Oriental department who enjoys a grant of £110, to be advanced to £140 at the beginning of the second school year. This is also possible at the beginning of the fourth year for those pupils who take up the study of the Chinese language during the last two years. Students who complete the five-year course of study may be appointed at once to the active service as consular attachés. Inasmuch as they are greatly favoured by the Foreign Office, their appointment to minor posts in the service is practically a certainty. That the academy is accomplishing the mission for which it was founded is evidenced by the fact that only a few months ago a new building was set apart for its special use.

THE SWEDISH MATCH INDUSTRY.

Match-making is one of the most important among Swedish industries. Between 1830 and 1840, Dr. J. S. Bagge, Professor at the Technical High School in Stockholm, made great efforts to obtain light by means of friction matches. Though the importance of ordinary phosphorus in the production of matches of this kind was tolerably evident, and had actually been pointed out by Berzelius, its use was purposely avoided, until it was discovered that really practical matches could not be obtained without phosphorus in their heads, and Professor Bagge himself drew up directions for their manufacture. Phosphorus matches have been manufactured wholesale in Sweden since 1843. The celebrated match factory in Jönköping was founded by Johan Edward Lundström in 1844. At first sulphorised phosphorus matches were almost the only kind made there. In the same year, 1844, however, G. E. Pasch, Professor at the Caroline Medical Institute at Stockholm, made the discovery that a rubbing surface containing amorphous phosphorus, called by Pasch, phosphor oxide, could be used for matches with heads containing no phosphorus. His invention was patented on October 30th, 1844—a date of importance as proving the priority of Pasch's invention against claims on behalf of a German inventor. The manufacture of matches according to the new patent at once began. According to a report by an official of the Swedish Central Bureau of Statistics, the method employed by Pasch for producing the phosphor oxide was not, however, a very practical one, and it was not until a cheaper method had been discovered in England, in 1851, that his invention was put to practical uses. In this also priority belongs to Sweden, for in 1852 the Jönköping Match Factory commenced to manufacture those "safety matches" which, at the International Exhibition, held in Paris in 1855, were pronounced the best of their kind. The matches turned out by the firm have since attained a world-wide celebrity, and there can be few commodities which have been so often imitated in all parts of the world, both as regards labels and general appearance, as the "Jönköpings Säkerhetständstickors" (safety matches). In the progress of the match industry it has been found necessary to make great use of labour-saving machines, and many machines had already been brought into use before 1870, more especially such as are calculated to simplify the arranging of the splints ready shaped in frames previous to their dipping in the igniting composition to form the heads. A. Lagerman, by his so-called "complete machine," contributed greatly towards reducing the manual labour in match manufacture to a minimum. The match material, which is first cut by other machinery, is fed into the complete machine at one end, to emerge at the other ready-made and packed in boxes, without the intervention of a single workman during the process. One of these machines turns out at least 40,000 boxes in the space of eleven hours. The first machine of this description started working in 1892 in the old Jönköping match factory. A large number of other match factories have sprung up by degrees, but many of them were very soon obliged to cease by reason of the severe competition. Though the old phosphorus matches were driven out of favour by the safety matches, they still continued to be made, but since July 1st, 1901, the sale of them in Sweden has been prohibited, on account of the danger connected with the yellow phosphorus contained in their heads. They possess, however, one advantage over the safety matches which cannot be denied them, and that is said to be the possibility of striking them on almost anything. Continued experiments and the offering of prizes have now resulted in the manufacture of matches which may serve as a substitute for the old phosphorus matches

without containing the yellow poisonous phosphorus, instead of which is used in the Jönköping factory, sesquisulphide of phosphorus. Most of the chemicals required in match-making, such as phosphorus, antimony. sulphur. paraffine, &c., must be imported; chlorate of potash, on the other hand, can now be obtained in Sweden. The sort of wood in greatest and almost exclusive request for matches is aspen; it is easy to cut up, and is sufficiently porous to admit of impregnation with sulphur or paraffine. The home supply of aspen wood of a sufficiently good quality for use in match-making, has now been so reduced that a considerable amount has to be imported from Finland and especially from Russia. The most serious obstacle to the progress of the match industry in Sweden, or even to its continuance in its present proportions, consists not so much in foreign competition as in the excessively high protective duties imposed by other countries to benefit their own manufactures—duties often so high as to preclude all importation — and also the State monopoly on the manufacture of matches established by several countries, *e.g.*, France, Spain, and Greece. The largest match factories in Sweden at present are the Vulcan Factory at Tidaholm, and the Old Factory and the West Factory at Jönköping. At some factories, the headless splints for matches are made for sale. This branch of the industry was estimated at £15,000 in 1900. Swedish matches are exported chiefly to Hamburg and London, for distribution to all parts of the world. In order to avoid competition between home manufacturers, and at the same time to facilitate the trade with foreign countries, the most important Swedish match factories have of late formed a joint stock company, of which the Vulcan Factory and the two factories in Jönköping are the largest shareholders. The total value of matches of Swedish manufacture exported from the country amounted in 1902 to £432,000, and in 1903 to £466,000.

THE PITCAIRN ISLANDERS.

In February of last year the High Commissioner of the Western Pacific instructed Mr. R. T. Simons to proceed to Pitcairn Island in order to inquire into its general state of affairs. Mr. Simons reported on June 25, 1904, and his report has just been published (Cd. 2397). It is rather melancholy reading. The islanders increase in numbers very slowly. In 1878 they did not exceed 90. In 1901 they were returned at 126. Mr. Simons puts them at 141, 68 males and 73 females. "The narrow-mindedness and seeming lack of intelligence noticeable in many of the Pitcairn people," says Mr. Simons, "are more due to ignorance, I think, than to any mental infirmity, and there are now on the island about 40 males and 30 females, ranging from one to seventeen years of age, in need of education and attention." Some years ago the islanders embraced the faith of the Seventh Day Adventists, a religious sect having its origin and headquarters in the United States, and the people contribute 10 per cent. of their produce, and of any moneys they may receive, as a tithe to the church. The produce so contributed is sold, and the proceeds, together with other cash collections, are forwarded to the Foreign Mission Board of the Adventists in America. The only market available for the islanders is Tahiti, and the only communication kept up with it is by means of a cutter, a small vessel of 14 tons, which plies more or less regularly between Pitcairn and Mangareva, where communication with Tahiti and elsewhere may be obtained at intervals of about three months; but there is no anchorage except occasionally in very calm weather. The voyage between Pitcairn Island and Mangareva is often long and boisterous, and no docking facilities are to be had at either place. Some years ago, before they adopted the Adventist faith, the islanders possessed many pigs. To-day there are none in the island. Coffee grows luxuriantly, and is of good quality. Once the islanders have pigs and coffee for export it would be an easy matter, Mr. Simons thinks, to arrange for direct communication between Tahiti and Pitcairn Island, and from the revenues to be derived from these pursuits the islanders should in time be able to procure machinery and appliances adapted to the manufacture of arrowroot, which is of excellent quality at Pitcairn, and worth commercially about £12 per ton.

Mr. Simons says the islanders are "a hard-working people, more or less healthy, exhibiting certain vicious tendencies, which education has been unable to eradicate." They have adopted an extraordinary *patois* (derived from the language of the Tahitian women who accompanied the mutineers of the *Bounty* to Pitcairn Island), which is employed in conversation among themselves, although "most of the adults can speak the English language fairly well." As to the morals of the islanders, Mr. Simons can say little in their favour. They use no intoxicants, but illegitimacy, petty thefts, brawls, and bad language are common, and "it was disquieting to learn that the laws and regulations dealing with those (and other) offences had seldom been enforced." The Government was formerly conducted by a magistrate, assisted by a council of two persons, but "owing to lack of strength and firmness on the part of Government officers," the people became dissatisfied, and in October, 1892, Captain Rooke, of H.M.S. *Champion*, suggested a change. On his recommendation, a president, vice-president, and a judge, and seven members of Parliament, charged "with power to legislate, to plan for the public good, to execute the decisions of the Court, and to see that public demands are speedily attended to," were elected by the islanders in the belief that "a larger number of officers will tend to make a stronger Government, and that plans for the public welfare will be executed with greater success." For some time this method of

administration worked fairly well, but within the last two or three years there has been inquietude. "During my visit," says Mr. Simons, "to the island, I perceived that the functions of the members of Parliament had become merged in those of the president; that the judges, annually elected, were often times incompetent to deal with the matters brought before them, and frequently incapable of enforcing their decisions; that jealousies among the officials had become rife; and that, in view of the general laxity observable, a radical change was necessary." A new system of government was inaugurated by Mr. Simons, and it is to be hoped that it will work better than the old one. The opening up of a system of frequent communication with Tahiti, and a better system of education, would seem to be indispensable if the Pitcairn people are to enjoy anything like prosperity on their very inhospitable island.

TRADE OF MEXICO.

Owing to the troublous times through which it had to pass during the greater part of last century, Mexico is only now beginning to come before the public as a possible country for investments, and there is no good reason why the United Kingdom should not take advantage of this prosperity. In the early part of last century the whole of the commerce of Mexico was practically controlled by British merchants and bankers, and even as late as the early seventies the advance of any undertaking was in a great measure due to British enterprise. But since the construction of the railways in 1875-88 the supremacy in all enterprises has passed into American hands, and there it is likely to remain. But British trade might have a larger share of Mexican orders if only its representatives were abreast of the times. With the development of the country, writes Mr. Bioruland, Clerk to His Majesty's Legation, in his report received at the Foreign Office on March 10 last (No. 3332, Annual Series), the opening up of new districts, both agricultural and mining, the building of the port works and other public works, the construction of railways, the sanitation of many of the large towns of the Republic, the starting of new industries, &c., an ample field is open for all kinds of articles which in former years were never even thought of for this market. Electricity, too, a power which, under the present conditions, seems destined to take the place of steam and water, supplies motive power in districts which last century were still considered to be too far from any centre to be of any importance either for commercial or industrial purposes. This furnishes a sufficient proof that commerce in general is in a more flourishing condition than formerly, and foreign capital has found its way into the country in almost every branch of industry. The Americans have taken advantage of this in a very great measure, and American enterprises are found in almost every State of the Republic, and many places are very prosperous. The Germans also are rapidly increasing their commercial interests in the country, many of the large breweries being controlled by German capitalists, and the hardware trade, both wholesale and retail, is in their hands; but the iron smelters and refineries are not German companies. Agricultural companies have been formed in many of the large cities of the United States for operation in Mexico, as also mining companies, but British influence is felt in very small measure as compared with the former.

The trade of Mexico shows considerable increase in the last six years, for which the returns are available, as will be seen by the following figures:—

Year.	Rate of Exchange.	Value of—	
		Imports.	Exports.
	s. d.	£	£
1897	1 11⅛	7,841,143	12,875,590
1900	2 0	13,094,480	16,881,554
1903	1 8¾	18,220,403	18,587,643

The excess of exports in the year 1897 was greater than in any subsequent year, yet the imports of the year were only about half what they were in 1903. The exports, though showing a steady increase, have not increased so rapidly in proportion as the imports. Turning to the percentage of the import trade of coal of the principal countries during the same period we have the following:—

Country.	Percentage.		
	1897.	1900.	1903.
United Kingdom	19	17	14½
United States	49	51½	53½
France	13	10¼	8¾
Germany	10	11½	12½

As usual, Germany is making headway, but the United States, from their geographical position, must control the largest share of Mexico's foreign trade. Mr. Bioruland makes what would appear to be very sensible suggestions for the quickening of British trade with Mexico. He points out that a careful examination of the country and people by competent persons is essential for ascertaining the wants and requirements of the country and its inhabitants, and though commercial travellers make periodical visits to Mexico they, as a general rule, only inquire into the special branches of commerce in which they are interested, and while they often receive sufficient orders to defray the cost of the going, the country in general does not reap any

advantage from merchandise put on the market in this manner. The business circulars just out continue to be for the most part unsuitable. If they were printed correctly, and in the language of the country, and were to contain the necessary information as to signs and weights, &c., much needlesss correspondence might be saved, and the importers would then be in a much better position to judge whether the goods fulfilled the requirements of the market. Then again English weights and measures always prove a difficulty to foreigners accustomed to the metric system. This question of weights and measures is one of great importance to countries like Mexico, where the import duties are collected on the standard of weight, and where all operations are conducted on the same basis. In many of the American catalogues, Mr. Bioruland says, the prices and discounts are also given, so that the actual cost of an article can be calculated before it is ordered.

THE ALASKAN SALMON FISHERIES.

During the past year there has been a marked decrease in the salmon pack of Alaska. In 1902 the season's catch was 2,631,320 cases, in 1903, 2,631,782, and in 1904 it was estimated at not exceeding 1,935,000 cases, a falling off in two years of 696,320 cases. Throughout the entire world there has been a large reduction of the pack of salmon, which approximately is only 2,810,000 cases for 1904, against 4,317,000 cases for 1902, a loss of 1,507,000 cases. This is an estimate which has been made by the United States Department of Commerce and Labour, and does not profess to be exact, as the detailed statistical reports are not yet all available. Notwithstanding this decrease in the volume of the pack, there has been a marked increase in its aggregate market value, the receipts for 1903 having been about 30 per cent. more than those of the preceding year, and from present indications it would appear that a further increase will be apparent in the complete 1904 figures. The steady decrease in the salmon pack of Alaska is due to constantly enlarging operations of the packers beyond the natural resources of the streams, and to unfavourable conditions under which the propagation of salmon is carried on. The regulations promulgated by the United States Departmeut of Commerce under the law require that persons engaged in taking salmon shall maintain suitable artificial propagating plants or hatcheries, and shall produce yearly and plant in the natural spawning waters of each fishery so operated, red salmon fry in such numbers as shall be equal to at least ten times the number of salmon of all varieties taken from the said fishery during the preceding year. Despite the safeguards which have been thus thrown about the salmon industry by the law and the regulations, and by the personal inspection given by the agents of the Government, the supply of fish, as has been noted, is steadily decreasing. It has been found impracticable to enforce adequate artificial propagation by private persons.

CORRESPONDENCE.

BRITISH WOODLANDS.

Sir George King writes:—I have just had an opportunity of reading Sir Herbert Maxwell's admirable paper on "British Woodlands" in the *Journal* of your Society.

As an old Indian forester I rejoice to see that the subject of British forestry is not allowed to lie dormant, and that the Society of Arts, which has for so many years done its utmost to stimulate this art, is still ready to encourage anyone who shows a real interest in a matter of such vital importance to Great Britain. Would that the Government were equally ready!

The report of the Select Committee of the House of Commons, which sat during the years 1885 to 1887, produced no appreciable result, and the report of the later Commission of 1902 seems, so far as I can ascertain, to have fallen exceeding flat. Beyond the establishment of a small school for lads of the gardener or woodman class under Mr. Hansen in the Forest of Dean, most of the recommendations of the Commission have, so far as I know, been neglected. Sir Herbert Maxwell's paper, backed as it is by Mr. Munro Fergusson, may, it is to be hoped, receive attention in Parliament. The discussion on this paper at the meeting at which it was read recalls to memory a valuable and suggestive paper read before the Society so far back as December, 1894, by that veteran Indian forester, General Michael, C.S.I., who has aptly been called "the Father of Practical Indian Forestry," and to whose initial success in the Madras Presidency, India may be said mainly to owe its present Forest Department. I have the General's paper here, and perhaps I may be allowed to quote from it two very important and inexpensive suggestions which the Commission of 1902 appear to have approved. These are, first, that encouragement and facilities should be given for the education of the class of man most urgently required for the successful working of forests in Britain, viz., a workman who would be content with a salary such as the average British landowner can afford to pay—say, from £60 to £100 a year, and who would not be above working with his own hands. Second, that the Board of Agriculture should maintain a small staff of trained officers, capable of giving sound practical advice about the present and future management of plantations, the services of these men being placed, free of cost, at the disposal of anyone desirous of planting waste land, or of improving already existing

woods. General Michael truly remarks that there must be a number of landowners, large and small, in Great Britain and Ireland, who can point to some acres of land on their properties which, by reason of their being next to worthless for cultivation or grazing, bring in only a shilling or two per acre per annum. Proprietors of such lands would doubtless be glad if they could see their way to render them more valuable for their children or grand-children, but they do not know exactly how to set about doing so. They have vague fears as to the trouble and expense which such improvements might involve, and these fears too often deter them from doing anything. It is here that State aid might advantageously come in; for confidence would probably be established by a personal interview on the spot with a member of such an advisory staff deputed by the Board of Agriculture, who could make suggestions as to details, and who could give a rough estimate of cost. Many a doubting landowner, General Michael says, would probably be both astonished and encouraged by discovering how small an outlay need be incurred in converting an odd and hitherto unprofitable corner of a property into a timber plantation. General Michael, in the paper just referred to, shows how, in many cases, only about £7 per acre would be required. I venture strongly to recommend to anybody interested in British forestry, a perusal of General Michael's paper on "Forestry and Forest Education," printed in the Society's *Journal* for 21st December, 1894. After that paper was read an interesting discussion followed in which Sir Clements Markham, Sir George Birdwood, and Sir Joseph Fayrer took part, and many of their remarks form excellent and instructive reading.

San Remo, Italy.

OBITUARY.

Sir JOHN BARRAN, Bart.—Sir John Barran, who died after a short illness on the 3rd inst., at his residence in London, was a member of the Society of Arts of considerable standing, having been elected in 1877. He was born in 1821, the son of Mr. John Barran, gunmaker, of Wandsworth. Early in life he settled at Leeds, where he founded a large clothing business, and became a prominent citizen. He was mayor of Leeds in 1870 and 1871, and in 1876 he became M.P. for the borough. He lost his seat in 1885, but was returned in the following year for the Ottley Division of West Riding, which he represented until 1895, when he was created a baronet. Sir John Barran was for many years a governor of the Yorkshire College, and he took the greatest interest in the founding of the University of Leeds.

GENERAL NOTES.

OPTICAL CONVENTION, 1905.—As already announced, an Optical Convention will be held at the Northampton Institute, Clerkenwell, E.C., from May 31st to June 3rd, inclusive.. An Opening Address will be given by the President, Dr. R. T. Glazebrook, M.A., F.R.S., on the evening of May 30th. The programme of the Convention includes papers and discussions on optical subjects, an exhibition of optical and scientific instruments, with demonstrations of instruments of special interest, and evening lectures and social gatherings. The mornings will be devoted to the papers and discussions, and many important papers are promised. These will be collected and published in a volume to be issued by the Convention; this volume will be obtainable by members at a reduced rate. Demonstrations of novel and important instruments will be given in the technical laboratories of the Northampton Institute during the afternoons. The Exhibition of Optical and Scientific Instruments will appeal to all users of optical and allied instruments, such as microscopes, binoculars, photographic cameras, projection lanterns, &c. It will be open daily from 12 to 10 p.m. during the Convention, and members will have free admission to it at any time between the hours mentioned. The catalogue, an illustrated volume of some 300 pages, descriptive of British optical and scientific instruments, will be issued to members at a reduced rate. Arrangements for the evenings are being made, and will include lectures and a conversazione. A lecture is promised by Professor Silvanus P. Thompson, D.Sc., F.R.S., President of the Optical Society. This will probably be given on the evening of Thursday, June 1st. On the afternoon of Saturday, June 3rd, an opportunity will be given for the inspection of the National Physical Laboratory, Teddington, at the invitation of Dr. R. T. Glazebrook, M.A., F.R.S., the President of the Convention.

ALIEN IMMIGRATION.—The return just issued "of the number of aliens that arrived from the Continent at ports in the United Kingdom in each month for the year 1905," shows an increase in the immigration as compared with 1904. The return is brought down to the 31st March, and if that month of the two years is taken the gross numbers are 20,115 for March, 1905, as compared with 16,888 for the same month of 1904. If deduction is made of the aliens known to be *en route* to other countries, the figures are 8,118 for March, 1905, and 5,899 for March, 1904. Deducting again the number of sailors included with the aliens, not described in the alien lists as *en route* to places out of the United Kingdom, the figures are further reduced to 6,828 for March, 1905, and 4,857 for March, 1904. Taking the gross figures for the three months they are 42,287 for the period ended March 31, 1905, and 34,437 for the

similar period of 1904. Deducting aliens *en route* the figures are 21,685 and 15,773 respectively, and again deducting sailors the figures are further reduced to 18,398 and 12,782 respectively. A note to the return points out that the figures as to aliens *en route* are incomplete inasmuch as "particulars on this point are not required by law to be furnished."

THE REVENUE FROM WINE.—The Chancellor of the Exehequer in his Budget statement complained that "the wine duties have for many years been a falling source of revenue." But a Board of Trade paper issued last month (Alcoholic Beverages, 1903), shows that the Customs Revenue—and of course there is no Inland Revenue—from wine has steadily increased. Thus the receipts in the years named were as below, 1902 being the latest given in the return:—

1892.		1897.		1902.
£		£		£
1,268,000	..	1,325,000	..	1,524,000

If Mr. Austen Chamberlain had said that the consumption per head had fallen he would have been right, although the fall has been very slight. The consumption was 0·38 in 1889, and the average of the last five years was 0·37. It is practically stationary. Mr. Austen Chamberlain lamented the decline in the import of wines from British possessions. But the production has not diminished. In Australia it has nearly doubled in ten years. In 1893 the total production was 3,567,025 gallons, in 1903 it had risen to 6,159,169 gallons. In 1893 the production of the Cape of Good Hope was 6,145,344 gallons, but that was an exceptional year; in 1903 it was 5,332,349 gallons. Not much wine is produced in other colonies. Ontario is credited with 500,000 gallons in 1900, but there are no returns for other years, and returns are also lacking for Cyprus and New Zealand.

WINDMILLS FOR SOUTH AFRICA.—German manufacturers appear to be devoting special attention at the present time to the demand which has sprung up for windmills in South Africa. Austrian manufacturers are also doing all in their power to get control of the South African market, and the American representative at Chemnitz says in a recent report to his Government that both the Germans and Austrians are making disastrous inroads into the market in the lines mentioned. This demand for windmills has arisen owing to the continued dry seasons in South Africa. The sinking of wells has become a necessity, and even the Government boring machines have been called into use to supply cattle with the necessary quantity of water to sustain life. Two kinds of motors are saleable, a light one for pumping water for cattle, and a heavier one to pump for irrigation purposes. Of the first kind there is a great variety on the market at Cape Town. The main points considered in purchasing such motors are lightness combined with great capacity, facility of removal from one place to another, and ability to be set in motion by the lightest breeze. Windmills answering these conditions are at the present time very scarce, and it would be well for British manufacturers to give strict attention to this market if they wish to retain it. Care should be given to the questions of packing and shipment. Duplicate parts should be available, so that broken machinery can be repaired at short notice. This is a point to which German manufacturers devote special attention.

REVENUE (COLLECTION OF TAXES).—The returns showing for each of the three kingdoms (1) the amount charged for House Tax, Land Tax, and Inhabited House Duty for the financial years 1903, 1904, 1905, and (2) the amounts and per-centage of same collected in each country by 31st day of January and 28th of February respectively in each of these years, hardly supports the general opinion that payments this year have been very much quickened by the pressure of the authorities. Taking England, the return shows that at the end of January, 1903, the per-centage collected was 32·4 as against 29·5 in 1904, and 35·0 in 1905; and at the end of February the per-centage stood at 56·0, 55·5, and 62·6 respectively. It is explained in a note that the year 1903-4 was a year of re-valuation of property assessed under Schedules A and B in England and Wales outside the metropolis. Re-valuations always cause some delay in the assessments under the schedules, and, as a result, the collection in the months of January and February, 1904, was retarded. Comparing then 1903 with 1905, and taking the end of February, the per-centages are 56·0 and 62·6 respectively. It is noticeable that in Scotland 95·8 per cent. had been collected by the end of February, 1905, and in Ireland only 50·09.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MAY 10.—The Native Races of the Unknown Heart of Central Africa." By VISCOUNT MOUNTMORRES. J. CATHCART WASON, M.P., will preside.

MAY 17.—"The Use of Wood Pulp for Paper Making." By S. CHARLES PHILLIPS, M.S.C.I.

MAY 24.—"Modern Lightning Conductors." By KILLINGWORTH HEDGES, M.Inst.C.E., Hon. Sec to the Lightning Research Committee.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 11.—"The Manufactures of Greater Britain. —III. India." By HENRY JOHN TOZER, M.A. HIS HIGHNESS THE MAHARAJA GAEKWAR OF BARODA, G.C.S.I., will preside.

MAY 18.—"Plague in India." By CHARLES CREIGHTON, M.D. SIR DENNIS FITZPATRICK, K.C.S.I., will preside.

COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. The DUKE of MARLBOROUGH will preside.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

MAY 16, 4.30 p.m.—"Excavation of the Oldest Temple at Thebes." By H. R. H. HALL, M.A.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

ALAN S. COLE, C.B., "Some Aspects of Ancient and Modern Embroidery." Two Lectures.

LECTURE II.—MAY 8.—Embroidery in England, 12th and 13th centuries—MS. illumination, painting and embroidery as secular arts in 13th and 14th centuries—Influence of work in one art craft (the Goldsmiths') on that in another (Embroiderers')—Types of ecclesiastical English embroidery 13th, 14th, and 15th centuries, compared with contemporary illuminations in MSS. — Designs for English embroidery gradually affected by developments in ornamental weaving abroad—Symmetrical and floral patterns taking the place of designs with figure subjects having an epical or story-telling interest—English secular embroidery of the 16th and 17th centuries — The "conceits" in embroidery of the Elizabethan and Stuart periods—Embroidery in costume in 16th, 17th, and 18th centuries—Aspects of modern English embroidery—the designs for it: different phases of its practice, for ordinary trading purposes, for more limited purposes, and for special occasions in connection with technical instruction—Embroidery.

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

LECTURE I.—MAY 15.—*Application of Electricity and Character of Load.* — Winding—Haulage—Pumping—Coal cutting—Other uses underground—Surface requirements—Generating stations—Cables and distribution — Lighting — Signals — Telephones—Shot firing.

LECTURE II.—MAY 22.—Alternating and direct currents — Precautions — Enclosed motors — Home Office rules—Costs—Typical and historical plants described.

The lectures will be illustrated by lantern slides.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Alan S. Cole, "Some Aspects of Ancient and Modern Embroidery." (Lecture II.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Sanitary Institute, Margaret-street, W., 5 p.m. Dr. Louis C. Parkes and Mr. W. Rolfe, "Housing in Mansions let as Flats."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Lt.-Col. C. Delmé-Radcliffe, "The Nile Provinces and Western Uganda."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Horace Fulton, "The Photo-Lino Process."

Medical, 11, Chandos-street, W., 8 p.m. Annual Meeting.

TUESDAY, MAY 9...Hellenic (in the Rooms of the Society of Antiquaries, Burlington-house, W.), 5 p.m.

Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Meeting.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Study of Extinct Animals." (Lecture III.)

United Service Institution, Whitehall, S.W., 3 p.m. Commander the Lord Ellenborough, "The Possibility of our Fleets and Harbours being Surprised."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. P. Butler, "Three-Colour Photography—with Examples."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8½ p.m. The Earl of Ranfurly, "New Zealand and its Dependencies."

Horticultural, Drill-hall, James-street, Victoria-street, S.W., 3 p.m. 1. Mr. N. Hayashi, "Japanese Horticulture." 2. Mr. R. Farrer, "Japanese Plants and Gardens."

WEDNESDAY, MAY 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. The Viscount Mountmorres, "The Native Races of the Unknown Heart of Central Africa."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, MAY 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Henry J. Tozer, M.A., "The Manufactures of Greater Britain. III.—India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Sir James Dewar, "Flame." (Lecture II.)

Electrical Engineers (in the ROOMS OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. H. Laws Webb, "Telephone Traffic."

Camera Club, Charing-cross-road, W.C., 8½ p.m. Colonel David Bruce, "In the Fly Country" (Central South Africa).

FRIDAY, MAY 12...Royal Institution, Albemarle-street, W., 9 p.m. Prof. Ernest Fox Nichols, "The Pressure due to Radiation."

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m.

SATURDAY, MAY 13...Royal Institution, Albemarle-street, W, 3 p.m. Prof. Marshall Ward, "Moulds and Mouldiness." (Lecture II.)

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FRIDAY, MAY 12, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 15, 8 p.m. (Cantor Lecture.) H. W. RAVENSHAW, "The Uses of Electricity in Mines." (Lecture I.)

TUESDAY, MAY 16, 8 p.m. (Applied Art Section.) H. R. HALL, "Excavation of the Oldest Temple at Thebes."

WEDNESDAY, MAY 17, 8 p.m. (Ordinary Meeting.) S. CHARLES PHILLIPS, "The Use of Wood Pulp for Paper Making."

THURSDAY, MAY 18, 4.30 p.m. (Indian Section.) CHARLES CREIGHTON, M.D., "Plague in India."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. ALAN S. COLE, C.B., delivered the second and last lecture of his Course on "Some Aspects of Ancient and Modern Embroidery," on Monday evening, 8th inst.

A vote of thanks to the lecturer for his interesting course of lectures was passed on the motion of the Chairman.

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, May 11; HIS HIGHNESS THE GAEKWAR OF BARODA, G.C.S.I., in the chair.

The paper read was "The Manufactures of Greater Britain.—III. India," by HENRY J. TOZER, M.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

SOCIETY OF ARTS AND LONDON INSTITUTION.

The following Resolution was passed by the Council of the Society of Arts at their meeting held on the 8th May, 1905:—

"In view of the feeling which appears to have been aroused amongst some of the Proprietors of the London Institution with regard to the proposed amalgamation with the Society of Arts, and the consequent probable difficulties of effecting a harmonious fusion of the two Corporations into a single Institution, the Council of the Society of Arts have decided not to take any further action in the matter, and hereby discharge the Committee which, at the instance of the Board of Managers of the London Institution, they appointed to consider the scheme for amalgamation."

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday afternoon, May 2; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said that he was well-known as the author of "Armour in England," (1897), "Foreign Armour in England" (1898), and "Ironwork" (1893-6). In 1897, 1900, 1901 he wrote the sumptuously illustrated catalogues of the Burlington Fine Arts Club on "Enamels," "Ironwork," and "Silversmith's work of European Origin;" and in 1904 he brought out his monumental work on "Old Silver Work, chiefly English, from the 15th to the 18th Centuries." Mr. Gardner had already read five papers before the Society, namely, on "Wrought Ironwork," in 1887, on "The Monumental Use of Bronze," in 1888, on "Enamels and Enamelling," in 1891, on "Pewter," in 1894, and on "The Revival of Tradesmen's Signs," in 1899.

The paper read was—

THE MONUMENTAL TREATMENT OF BRONZE.

By J. Starkie Gardner, F.S.A.

Seventeen years ago I had the honour of addressing this Society on the subject of "The Moumental Uses of Bronze." I then confined myself to illustrations of sepulchral monuments. Not many weeks since, my friend Mr. Marion H. Spielmann also read here a paper on Royal monuments, describing those erected and in process of erection to the memory of our great Queen Victoria and her mighty contemporaries, the Emperor William and King Victor Emanuel, all three builders of Empires. There remains, however, a vast field to which not one but many meetings of this Society might be usefully devoted. Commemorative monuments, indeed, may be classified into five great groups: Religious, Sepulchral, Allegorical, Historical, Iconographic, each a subject for separate treatment.

Those designed to honour divinities, lest unseen their awful power should be forgotten, are the earliest of which we have any knowledge. These were visible symbols if not actual habitations of the gods, or temples set apart for their cult. Later, temples were erected with more mixed motives, but always with the dominant, if unexpressed, idea of bettering the life to come. Associated with religious beliefs, they took the practical form of providing places of worship for the people and domiciles for the priesthood. The few other religious monuments, as fountains dedicated to the Virgin, or isolated statues of saints, are exceptions of slight importance.

Another group marks the burial-place and perpetuates the memory of illustrious dead. These sepulchral monuments assumed at times vast proportions, like the Pyramids, the Mausoleum, the Castle of St. Angelo, the Taj Mehal, the Medici Chapel, the Cenotaph of Maximilian, and the Chapel of Henry VII. Like the Wellington Monument in St. Paul's, and the Royal Mausoleum at Windsor, they denote the actual places of interment.

Another more fanciful and poetic group consists of impersonations of the forces of Nature, of the Attributes, Passions, the Past and the Future, as well as concrete things, such as rivers, and people, by means of symbolic or allegorical imagery. The Greeks and Romans delighted in these, and they continue to appeal to the multitude even at the present day. With us no symbols are more popular than Britannia, the British Lion, and John Bull. The series of seated statues of the cities of France around the Place de la Concorde in Paris, erected with no such motive, serve in no small degree to keep green the memory of the losses of the Franco-German war.

An equally imaginative group is the Historical, commemorating auspicious or important national events. These are for the most part set up in public places and take varied forms, the most usual being arches, columns, obelisks, cairns, and allegoric statuary. These monuments, so important among nations of antiquity, had fallen into disuse in Europe until revived by Charles V. and Louis XIV. The Columns of July and Napoleon, our own Monument, the Arcs de Triomphe and du Carrousel, and the Portes St. Denis and St. Martin are conspicuous examples.

The last and by far the most numerous group is Iconographic, or erected to commemorate the deeds, virtues, and appearance of famous personages. These were equally familiar in ancient Greece and Rome, but forgotten later until the classic revival in the Italian Renaissance led to the production of monuments resembling those of antiquity. Our Nelson and Duke of York columns and Albert Memorial are familiar examples, but such memorials more commonly take the less ambitious form of simple portrait statues.

We in England have shown little interest hitherto in monuments commemorating past events, however important, and few are of historic value unless sepulchral. The commemoration of our monarchs and greatest men in bronze or marble was never a national concern until late in the seventeenth century. The men themselves, or their immediate heirs, erected the monuments that exist, as well as countless others that have perished through fire and decay. Had the customs of Greece or Rome by good fortune been maintained, statues would have been set up to most popular heroes of the day, and the likenesses of hosts of interesting personalities preserved and now be familiar to us.

Setting aside sepulchral monuments, with which I do not propose to deal, the most ancient and the most touching is the series of stone crosses erected to mark the resting-places of the bier of the beloved Queen Eleanor, of whom we have fortunately a splendid portrait in bronze in Westminster Abbey. For the most part the crosses have long since crumbled away and been removed, but one especially is perpetuated for ever in

the name "Charing Cross." The sentiment that dictated the erection of these and its mode of expression have remained unique. A long interval elapsed before any other commemorative monument was set up in London, and then it needed nothing less than the apalling destruction of the entire City proper with all its churches and historic buildings, to awake in the English mind a sentiment that had been so predominant in ancient Greece and Rome. "The Monument," so called because there was no other, remains practically unique in England, and except in the naming of Waterloo-bridge and Trafalgar-square, there is no visible sign that the nation cares to perpetuate the great events which have built up its history. But for the Guards' Monument there is nothing publicly commemorating the Crimean war; there is no sign of any national monument in remembrance of our struggles for supremacy in South Africa; and even the arrival of "Cleopatra's Needle" failed to make us realise that in it we possess the most fitting memorial of our occupation of Egypt. Monuments of stirring national events should provide history written large and artistic object-lessons for the people. To ancient historic monuments we are indebted for our sole accurate knowledge of the actual arms and appearance of such mighty historic nations as the Egyptians, Assyrians, Medes, Persians, Dacians, Scythians, Greeks, Romans, Gauls, indeed of every nation that has made up the world's history. A Roman triumphal arch affords the only actual representation of the mystic seven-branched candelabrum of the Jewish Temple, while Trajan's column presents a minutely accurate representation of the chain-mail and weapons that proved as fatal to Crassus, as to the English at Hastings a thousand years later. Our neighbours across the Channel show a thorough appreciation of the value of grand commemorative monuments. The columns of July and Napoleon, their triumphal arches, the Trocadero, the bridges, and names of streets and places keep alive the national glories and chequered career of the great nation. Already most of these monuments are mellowing into historic value, just as in time to come even our indifferent Guards' Monument will serve not only to preserve the memory of our first great struggle with our secular enemy but will record the exact costume of those who fought the battles. How valuable contemporary monuments in bronze would be to us of the heroes and rank and file who won our historic victories. Our pride in our Empire should surely induce us to hand down the presentment of those of us who fight our country's battles, and also of their gallant foes, whether Zulus, Afghans, or others. With no very earnest or successful antiquaries among our living sculptors, it is perhaps unwise to attempt to construct monuments commemorating anything but the immediate past and present, for certainly Boadicea, in her scythed chariot, and the warrior waving a sword in Palace Yard, with bronze bas-reliefs on the pedestal, do not appeal to us as historically accurate; but the great events of our own day, the Union of the British Isles, the Federation of the Colonies, and the Consolidation of our Indian Empire, our political freedom, and that of the Press, might be treated seriously, if competitions were open to all British subjects. An Alfred Stevens may exist among us, or some scenic artist or poetic dreamer might give birth to ideas for the professional architect and sculptor to realise. My own experience is that the power to design and the power to execute do not necessarily or invariably occupy one cranium. The dearth of reasonable presentments of our historic worthies in the public spaces of our metropolis has only been lessened of late by the portrait in bronze of Cromwell; and the Achilles in Hyde-park still remains our only symbolic statue, against the scores set up in other capitals.

Contrasted with those of Paris, our monumental efforts appear insignificant indeed. Emerging a few days since from the Louvre on to the Place du Carrousel, I was at once faced by a series of superb monuments, including that to Gambetta. A few steps west led by the triumphal arch with its bronze quadriga to the Tuileries gardens, where I was confronted with a galaxy of statues and groups, comprising two fine groups of lions, and rhinoceros and tigers, in bronze. Continuing to the Place de la Concorde, I found myself in the presence of the great Luxor Obelisk and two splendid fountains, around which are placed in solemn dignity the great statues emblematic of the noblest cities of France. Beyond, again, are other monuments, including the Marly Horses, the vista being closed by the great Arc de l'Etoile. Grand monuments meet the eye in every part of Paris, and, unlike ours, are effectively placed, and appear to be purposely designed to occupy the positions in which they are seen, frequently amidst trees and flowers. Our monuments, on

the contrary, are generally designed before any position is allotted to them.

In our vast metropolis—laid out for the most part to accommodate the high number of inhabitants by the great landowners, who parcel out the largest part of its area—there are fewer magnificent sites for monuments than in cities laid out by monarchs or powerful corporations. Most of the open places of London are enclosed squares and gardens closed to the public, each of which in Paris would be laid out with palms, plantains, and flowers, and seats around some central fountain or artistic monument. At some not far distant time the happiness of the many may be regarded as more worthy and pleasing than the solitudes of which so few make use. Meanwhile, several fine sites for monuments are available. A new and splendid *façade* to the National Gallery, with loggias and statues, and Trafalgar-square remodelled as a broad approach to it, could commemorate the federation of the Empire. Parliament-square, with its majestic surroundings, would also provide a matchless site for a noble commemorative monument. There are other less important sites, though it is unfortunate that the few commanding spaces at the intersections of main thoroughfares, created by our municipal councils, fit for the reception of beautiful objects, have been seized upon by the sanitary department for underground conveniences which a refined taste would have gladly relegated to equally accessible but less prominent situations.

It must be quite obvious that monuments that tell in London are not the ordinary portrait statues in garments which do not lend themselves to artistic treatment, and on which so many thousands of pounds have been expended without adding one touch of beauty to the town. Monuments to be telling in London must either comprise more than a single figure, or be of larger size than the heroic size sanctioned by tradition or, best of all, be equestrian. A rider on his steed assumes a dignity of pose embodying mastery of an animal many times more powerful than himself, which is most gratifying to humanity. Monuments might assume grander proportions were kindred spirits to be commemorated, associated in groups, or as parts of a whole. Britannia and some of her statesmen might symbolise the union of the British Isles; Neptune, with seamen and navigators our vast maritime power; Victory and warriors a victorious reign. Allegories of Commerce, Science, Peace, Prosperity, Wealth, Fortitude, Charity, Justice, Mercy, Truth, are all capable of artistic treatment, and would elevate the thoughts of the gazer and passer-by, which I take to be the chief reason for setting up monuments, which are not erected merely for

FIG. 1.

ANCIENT PYTHIAN TRIPOD FROM THE TEMPLE AT DELPHI.

pomp and vain glory. Such might take the form of groups, or combine with columns, triumphal arches, fountains, or bridges—which will perhaps provide the most important sites we are likely to acquire in the near future under existing *régimes*. Mediæval bridges with their defensive gates, chapels, and figures

of guardian saints, were picturesque objects. In the cases of Blackfriars and Westminster, we have realised the difficulty of decorating bridges not designed for the purpose of receiving statuary; while visitors to the Paris Exhibition realised on the other hand the surprising possibilities afforded by bridges when designed to be commemorative. Instead of the commonplace pannier-like widening of London-bridge, it might have been converted into a glorious monument to the British Navy; while the new bridge at Vauxhall might have been fitly made to commemorate the services of the Household Brigade in Egypt and South Africa; the purely utilitarian expenses being defrayed as heretofore, and the monumental features by subscription.

I fear I have trespassed on your time by this discursive preface. But the loss, all too recent, of a beloved and one of the greatest monarchs of our history, and the losses incidental to the far-reaching struggle in South Africa, have turned the thoughts of all towards the subject of memorials. The spirit of Empire too, seems in the air, beginning to stir the pulse of the nation, and perhaps ideas now sown, may, like grains of mustard, produce large results in the future.

I shall now proceed to exhibit a very few examples of monuments of the past, limiting them to those of bronze which, in our climate, is the only material suitable for sculpture exposed to the elements. In the short time at our disposal these must obviously be limited to one or two minor groups. Objections and difficulties notwithstanding, it is unlikely that committees who manage these things will set aside the full-length portrait statue. We have no recognised embodiments of the powers of nature, like the Greeks had, Zeus, Athena, or Apollo, to represent and idealise, neither do we commemorate victorious athletes in the nude, nor is the general attitude of the populace encouraging as yet. In ancient times it was one of eager expectancy, and general acclaim rewarded the sculptor when one of his triumphs was set up. This was so in the halcyon days of Greece, Rome, Italy, and it is still seen, to some extent, in France, as we saw at Bordeaux a few days since, when the unveiling of the Gambetta monument amounted to a national fête. Even Germany and other countries contrast favourably with the utter apathy of the English, who seem collectively to have lost touch with everything truly artistic. Added to this is the difficulty of modern costume, which proves an almost insurmountable and always distressing problem to the modern sculptor. If those he habitually commemorated were champion swimmers, oarsmen, football, or tennis men, the matter would be otherwise; but, unhappily for art, those deserving of statues are great statesmen, like Joseph Chamberlain, scientists, benefactors, and so on, and the costume in which we know them best, the tall hat and eyeglass, the immaculate frock-coat and well-stretched trousers, the starched waistcoat and stiff collar, must make artists despair, however well-knit and alert the original may actually be. Only the few can be portrayed in majestic draperies, like kings and German emperors.

With animals, the sculptor is on safe ground; they present their natural grace and beauty unspoiled by art. The most venerable bronze in existence, still resisting the ravages, not of centuries, but of milleniums, and yet retaining its ancient position in the hippodrome at Constantinople, where it was set up as a trophy when Christianity was in infancy, is the ancient Pythian tripod from the temple at Delphi (Fig. 1). It is formed of intertwining snakes, now headless, and the monument is now sunk in a deep pit, a witness to the change in the level of the ground brought about during the centuries it has stood erect at Constantinople.

Once in near association with this, and no less venerable, are the four bronze horses of St. Mark's, removed from the hippodrome by Doge Dandolo in 1204 (Fig. 2). They originated in Greece, probably in the fifth century B.C., and after adorning several triumphal arches in Rome, were transferred by Constantine to his new capital, whence they found their way to their present position over the porch of St. Mark's Cathedral in Venice. They formed part of a quadriga, and were formerly gilt, and are said to be of pure copper cast extremely thin, hardly one-sixth of an inch in thickness, and are thus triumphs of the founder's skill, unless they are hammered work. The head and neck were cast separately, the junction being hidden by the collar. Parts of the horses, being ungilt, show where the trappings formerly existed, and there are holes for its attachment. Their frequent removals have caused injuries to the lower parts of the legs, and some of the gilt trappings and ornaments disappeared after the French had taken them to Paris and been compelled to restore them. The bodies are round, the necks short and muscular, and the heads superb. A bronze horse of the same date, but mutilated, is in the Conservatorio at Rome. The third illustra-

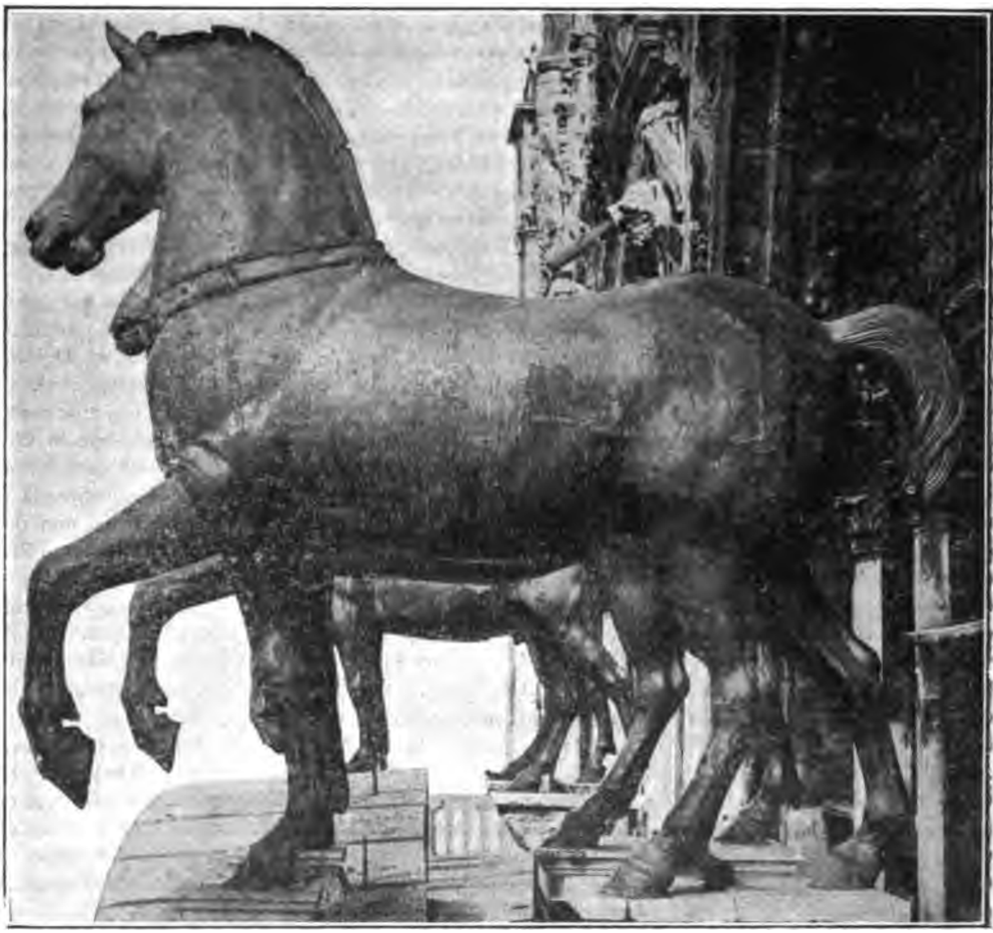
tion is also of venerable antiquity, and by far the most ancient bronze equestrian portrait statue in existence. It stands in the Piazza del Campidoglio at Rome, and was placed on its present pedestal by Michelangelo in 1538 (Fig. 3). The figure is that of Marcus Aurelius, bareheaded and in simple drapery, seated in an easy attitude upon a saddle cloth or saddle of singular construction.

There is a long interval between this and the next equestrian statue, which is said to be of iron, and not bronze. This is the St. George and Dragon in the Cathedral square at Prague, made by Martin and George Clussenbach in 1373, and shows armour partly scaled and partly of plate. It was partially restored in 1562. There is a cast of it in the Victoria and Albert Museum.

There is mention of a cast of an equestrian statue of St. George being in England in the time of Richard II.

Equestrian statues were produced in Italy during the Renaissance, the earliest being that of Gattamelata, by Donatello, in the Piazza in front of the great church at Padua. (Fig. 4). This celebrated commander of the Venetian Army in 1438 is in the armour of the period, truncheon in hand. He is bare-headed, with curly hair and a slight beard. An enormous cross-hilted sword is slung at his side, and he wears the long rowelled-spurs of the fifteenth century. The horse is short-necked, and

FIG. 2.



BRONZE HORSES AT ST. MARK'S, VENICE.

extremely powerful, the tail being twisted into a knot.

An even finer statue is that of Bartolomeo Colleoni, another Captain-General of the Venetian forces, who died in 1475, and was one of the first to use field cannon in war (Fig. 5). He is sheathed in richly decorated armour, and wears the Venetian salade and short rowelled-spurs. The horse, like that by Donatello, resembles those of St. Mark's, but with more vigorous action. The saddle is high, back and front, and richly decorated like the harness; the feet are in stirrups. The statue stands in front of the church of SS. Giovanni e Paolo, in Venice. It was modelled by Andrea Verrocchio, who, however, died in 1488, leaving it to be cast by Alessandro Leopardi, who completed it in 1496. This is probably the finest equestrian statue in existence, the pose is superb, and horse and rider present an irresistible force.

Passing over the French equestrian portrait statues, most of which were destroyed in the Revolution, we come to those of our own country. The only one still remaining of the seventeenth century is that of Charles I. at Charing-cross, by Hubert le Soeur, a French pupil of John of Bologna. It was cast in London in 1633, at the expense of the Howard family, and saved from destruction during the Rebellion by John Rich, a brasier, who presented it to Charles II., in whose reign it was re-erected in 1674. This graceful and commanding bronze statue has been erroneously described as of lead. The same artist commemorated James I. by a bust over the principal entrance to the Banquetting-house, and both James I. and Charles I. by statues now on each side of the choir at Winchester Cathedral. An equestrian portrait of Charles II. was set up in the Stocks' Market by Sir Robert Vyner in 1672, which had a similar fate to the George II., of lead, brought from Canons, the seat of the Chandos family, and set up in Leicester-square in 1754. The statue of George III. in Cockspur-street was not erected till 1837, and is by Matthew Wyatt, and the George IV. in Trafalgar-square was not completed till after the artist's (Sir Francis Chantrey) death in 1843. It would be easy to produce faithful representations of at least Elizabeth, Cromwell, William III., and Marlborough, and who would all form splendid subjects for commemoration in this manner.

Statuary was formerly rendered realistic by colouring, and the material chosen mainly for texture, more than one material being used for producing a single figure. Ivory for the flesh and golden drapery was most favoured, but Parian, Naxian, and Pentelic marble, probably left white for the flesh, with coloured hair, eyes, &c., and drapery, were most often used for female figures. Sometimes the head and limbs only would be marble and the rest of porous stone filled in with stucco and strongly coloured. There can be little doubt as to bronze having been chosen to represent athletes and demigods from its colour resembling the sunburnt bodies of these, and probably the original colour was carefully maintained. Otherwise the pallor of death given to Jocasta by alloying with silver, and the red blush of shame to Athamas, by iron, as Pliny says, would have disappeared under the ordinary patina, even under Grecian skies, after a few days' exposure. We are accustomed to admire bronze for its patina, and to take pleasure in the varying shades of rich browns and greens it assumes everywhere away from our fuliginous cities, and cannot understand the obvious admiration of the ancients for the natural golden glint of the well scoured metal, often replaced by actual gilding. But then we are equally unable to realise their love for polychromatic statuary, the idea of painting or staining marble being repugnant to us. We even dislike, or are slow to replace, the gorgeous blue, scarlet and gold decoration of the carved stone interiors of our perpendicular churches and screens.

Admitting that art bronzes are to be patinated, the question of the best means of controlling and producing the tones becomes of interest. The Japanese excel in this. Our own empiric methods range from inhumation in a dung heap, to suspension up a smoky chimney—preferably where wood or peat fires are burnt, besides acids and alkalis and trade solutions, the components of which are secrets. The exhaustive researches on the cooling of bronze alloys carried on within the past few years shows that the metals remain separate and crystalline, but present structures as diverse as those of the porphyries, gneisses, and granites, according to the rate at which they are cooled. The tones of the more delicate natural patinas would be considerably affected by the internal structure of the alloy. The chemicals useful for the purpose will be found chiefly among the muriates, ammoniates, and sulphides.

The time remaining at my disposal must be given up to a form of monument which was practically never known in England, and

Fig. 3.

Marcus Aurelius, Piazza di Campidoglio, Rome.

the high symbolic import of which is even yet scarcely appreciated.

When not only palaces and pleasaunces, but every edifice, sacred or lay, and every city, was closed with defensible and well-nigh impregnable gates, the question as to whether these would be found open or shut must have been of the most momentous. The hope of the night's shelter, warmth, and food hung upon the contingency, and oft the traveller must have been met with the stern rebuke, "Too late, too late; you cannot enter now." Inevitably the imagination fenced in the places to be desired in a future life with gates, inexorably closed except to the favoured few. The keys of the gates of Heaven or Paradise were committed to St. Peter, rarely to be opened to anyone without intercession, but the gates of Hell and Purgatory gaped wide. Open or shut, gates were the focus of interest, and could not be approached in primitive days without awe, curiosity, or emotion. It is hence not surprising that they were sumptuously and magnificently decorated. The Roman triumphal arch was only the apotheosis of the gate, recalling difficulties gloriously overcome. The question, figuratively, of the open or closed door to commerce is almost the only one about which civilised nations might still go to war.

In the days when iron was little used, the massive wooden doors were sheathed, for protection from fire and for strength, in bronze, and revolved upon massive bronze hinges. Upon these were sometimes pictured the mighty deeds of the monarch of the country. The bronze portions of two pairs of enormous doors were found many years since by Mr. Harmuzd Rassam in excavating at Balawat in Assyria. The city contained a palace standing in a long rectangular enclosure, with four entrances, near two of which the remains of the doors were found. The larger were about 22 ft. high, 6 ft. wide, and 3 inches thick, each leaf being attached to a cylindrical post, about 18 inches in diameter, to which strong bronze pivots were fixed, working in stone sockets. Across each door seven or eight plates of bronze 11 inches wide were fixed by nails at regular intervals, these plates lapping round the post. On each of these plates are representations of the Assyrian army on its war path, and other events of the first 9 years of the reign of Shalmaneser II. These are in two bands of *repoussé* work, executed with great fidelity and spirit, and much freedom of drawing. Between embossed bands narrow spaces are left, relieved at regular intervals with the rosettes through which the nails are passed that fixed the plates to the woodwork of the doors. The "brazen gates" of antiquity were probably of this kind, and we are singularly fortunate in the possession of these splendid examples by our national museum.

Of the Roman period, there are several bronze doors, but of a different type and not depending on wood for their construction, still preserved in Rome itself. These are the large central doors of St. John Lateran, decorated with foliage, and brought from the Æmilian Temple in the Forum, and of about the date of Our Lord. Another pair, brought from the baths of Caracalla, and of about the third century, close the oratory of St. John the Baptist, in the church of S. Giovanni in Fonte, the ancient baptistery in Rome. The vast bronze doors of the Pantheon remain in their original position, dating possibly from the time of Agrippa, 31 B.C. The doorway of marble, 39 feet high and 19 feet wide, contains their massive framing, consisting of two bronze pilasters, to which the doors are hinged, and the lintel over them which is a pierced bronze scale pattern grille. The doors themselves are not decorated in relief, but are of severe and dignified simplicity.

Next in point of antiquity are the Byzantine gates which revert to the partly wood construction of the East. Examples of these still exist in Constantinople, but the best known are the bronze doors to the vestibule of St. Mark's, in Venice. Some of these were brought from Constantinople, it is supposed from S. Sophia, after its reconstruction by Justinian, and may date back to the sixth century. Three of the oldest are divided into four panels of double arches with crosses and foliage rising out of vases under each arch. The other two are in the later Byzantine style, the central one, of early eleventh century, divided into forty-two framed panels inlaid with figures of saints in silver, the heads of some in relief, and a lower row of six panels decorated with bosses only. The frames are broad and studded with bossed nails, and twisted pillars separate each row of panels vertically. The remaining door is treated similarly, but divided into twenty-eight panels with figures, and is older since the inscriptions are in Greek characters. The framing of the panels are richly decorated with geometric and florid designs, and there is a central row of six lions' heads among the bosses. In the large

FIG. 4.

GENERAL GATTAMELETA, BY DONATELLO, AT PARDUA.

central doors these are replaced by a row of eight lions' heads with rings, and the inscriptions identifying the prophets and saints are in Roman characters.

Next in age are the principal doors from the venerable Abbey Church of Monte Cassino, executed by order of Abbot Desiderio, later Pope Vittorio III., 1088. They also are inlaid with silver curiously reciting a list of the properties held by the Abbey in 1066. The crosses at the base are like those of the earlier doors of St. Mark's. The Cathedral at Amalfi has doors similarly ornamented; and the doors of the Cathedral at Salerno, erected by Robert Guiscard, are also inlaid with silver, and were executed at Constantinople in 1099. Other examples exist.

The central doors of the Cathedral of Benevento are divided in seventy-two panels, filled with bas-reliefs, except four containing lions' heads with ring handles. Those above represent scriptural scenes crowded with figures, and below are single saints under simple canopies. The framing is made of egg-and-tongue moulding, with large rosettes at the intersections. They are supposed to have been made in Constantinople in 1150.

There are exceedingly interesting bronze doors at Canosa closing the Mausoleum of Boemond, the son of Robert Guiscard: portions of the cathedral doors of Susa, of Byzantine eleventh century work, are preserved in the treasury of that cathedral.

FIG. 5.

BARTOLOMEO COLLEONI AT VENICE.

Bronze doors of Italian make first appear in the twelfth century, the earliest artist of whom we have definite records being Barisano da Trani. The bronze doors to Trani cathedral, made in 1160, are his work, and are divided into 32 panels of subjects in relief with rich scrolled borderings, and mounted on hard wood. The side doors of Monreale are by the same artist, but somewhat later, divided into 28 panels with reliefs and excessively rich borderings. Even finer are the doors of the Cathedral of St. Pantaleone, at Ravello, by the same artist, and produced in 1179. The figures are

very varied and of some merit, considering the date, and constitute a landmark in the history of Italian art. Equally celebrated for bronze work is Bonanno da Pisa, who produced the great central doors of Monreale in 1186. The entrance is arched and richly sculptured, and the doors are divided into 40 small panels, with scriptural subjects in relief, and in plain frames studded with rosettes, and separated vertically by bands of acanthus foliage treated conventionally. At the base are two lions and two griffins, and above are enthroned the Saviour and the Madonna with angels. To the same artist we owe the doors of the Baptistery at Pisa, less important as to size, but more delicate in design and workmanship. To the last year of the thirteenth century belong the well-known open-work scale pattern doors of St. Mark's, Venice, inscribed "MCCC + Magister Bertucius Aurifex Venetus me fecit +." The details of these are noteworthy.

The doors of S. Zeno Maggiore at Verona are in the Italian style, but have been assigned to an unknown German artist, who produced them in 1178. They comprise 48 panels with scriptural subjects in relief and two with large heads, serving as knockers or closing rings. They betray a slight tendency to the grotesque, but the architectural details seen in the panels are of great interest, suggesting an Italian source.

With the appearance of Andrea Pisano in the fourteenth century, we reach more familiar ground. He was commissioned in 1311 to make the doors to the baptistery of the cathedral in Florence, designed by Giotto, being regarded as the best artist for the purpose to be found in all Italy. They occupied 22 years, notwithstanding the assistance of his son and two fellow artists, Lippo Dini and Piero di Jacopo, and were cast in Venice by Master Leonardo del Avanzo, and finally gilded by fire in 1339. They were shifted from the northern entrance to make way for the gates by Ghiberti, and re-erected at the south. They consist of 28 panels with scenes from the life of the Baptist in relief, placed in barbed quatrefoils with rectangular moulded framing, studded with bosses and lion heads in relief. When they were set up the Signory came in solemn state to applaud the artist and confer on him the dignity of citizenship. The architrave was added by Ghiberti, who made a corresponding pair of doors or the northern entrance in 1403, when he was but 22. These occupied 21 years, though many assistants were employed, including his father-in-law, Bartoluccio, a great silversmith. They weighed 34,000 lbs., and cost 16,204 florins. Founded on the work of Andrea Pisano they nevertheless show marked progress in Italian art. In 1425 the same Lorenzo Ghiberti was commissioned to execute the central doors, spoken of by Michel Angelo as worthy to be the gates of Paradise. They mark an entirely new departure, a striving for pictorial effects, to an extent never before attempted. Ghiberti has left on record that he "strove to imitate nature to the utmost, and by investigating her methods of work to see how nearly I could approach her. I sought to understand how forms strike upon the eye, and how the theoretic part of sculptural and pictorial art should be managed. Working with the utmost diligence and care, I introduced into some of my compositions as many as a hundred figures, which I modelled upon different planes, so that those nearest the eye might appear larger, and those more remote smaller in proportion." Perhaps the novelty led to the somewhat exaggerated praise. The founding was commenced in 1440 and completed in 1452 at a total expense of 14,594 florins. They thus occupied 27 years, or, according to Vasari, 40! The scenes are from the Old Testament, and fill the 10 panels. The framing comprises 20 statuettes in niches and four recumbent figures, and 24 heads in the highest relief, among them one of the sculptor himself. The framing of the doorway, also of bronze, comprises foliage, fruit, flowers, and numerous animals and birds, all in high relief.

Florence also boasts two small pairs of doors by Donatello for the sacristies of the church of S. Lorenzo, with 10 panels in relief of saints and martyrs. These were produced in about 1457, 11 years before his death. There are also bronze doors to the sacristy of the cathedral by Luca della Robbia, executed in 1464, comprising 10 panels of subjects in high relief, which have almost the finish of silverwork, and were highly commended by Vasari.

A pair of magnificent bronze doors were cast for the Triumphal Arch of the Castel Nuovo at Naples, erected by Pietro di Martino for Alfonzo of Aragon to commemorate his entry into the city in 1443. They occupied 19 years, not being finished until after his death—a grief to a prince known as the Magnanimous, and a great patron of art. Guglielmo lo Monaco of Umbria completed the work in 1465. They are divided

into six large panels, the two uppermost forming segments of an arch, all crowded with figures of mounted men-at-arms in battle array, with citadels in perspective in the background.

The art of bronze-founding had, no doubt, attained its zenith in Italy in the fifteenth century, yet to the sixteenth belongs the superb door to the sacristy of St. Mark's, Venice, by Jacopo Sansovino, produced about 1529, when he was appointed architect and sculptor to the Venetian Republic. It is divided into two panels, with scenes from the life of Christ, bordered in the manner of the later Ghiberti gates, the portraits being, however, of great interest, since they are those of himself, Titian, Aretino, Paul Veronese, Giorgione, and Tintoretto.

The front of the cathedral at Loreto has three pairs of most sumptuous doors, the central by Girolamo Lombardi, of Ferrara, and his sons, who worked on them from 1534 to 1560. They comprise six large and eight smaller panels, illustrating the story of Adam and Eve, with richly worked borders. The left-hand doors are by Tiburzio Verzelli da Camerino, of somewhat later date, but corresponding generally in design, and those on the right by Antonio Calcagni, each having employed several assistants.

The seventeenth century produced the three magnificent doors to the Cathedral at Pisa, by John of Bologna, executed in 1602, evidently inspired by the later door of Ghiberti in Florence. The principal panels represent scenes from the life of the Virgin, and the borders comprise branches of laurel and of orange, roses, figures, &c, with a considerable tendency to realism. He employed several assistants.

The last of the illustrations shows the bronze gates of the Campanile Loggia in Venice, to our taste perhaps wanting in repose, but comprising some fine modelling. Gates of this sort are almost confined to Italy, and few exist anywhere wholly of bronze unless closing an arch or entrance. Little appears to be known of the artist—Antonio Gai.

It may have been noticed that the doors were originally modelled on the lines of the strongest form of wooden doors known, and the interspaces occupied by the panels are therefore necessarily reduced to very small dimensions. Ghiberti was the first to abandon the strongly constructional form and introduce larger panels, and these were generally adopted, until in the doors at Naples there are only three panels to each leaf.

In England we have rarely since mediæval days, when splendid iron-work was laced over doors to give them strength, been conscious of the decorative value of metal for doors, though the Italian artists had for centuries lavished their finest work upon them, and many were famous *chefs d'œuvres*. The oldest bronze gates we have close the entrance to Blenheim Palace. In London there are bronze gates closing both the Marble and Wellington arches, and there is a pair in the central arch to Buckingham Palace. Those for the Marble Arch cost 3,000 guineas.

There are many occasions when relatively small sums are available for commemoration, and many sites where beautiful gates, whether of iron or bronze, would add greatly to the importance and dignity of the scene. Memorial gates can be and are produced at from £60 to several hundred pounds, in iron, and I have plans before me for bronze gates running into thousands. When these are executed it may be interesting to describe the process of manufacture from the commencement. A very fine pair of bronze doors for a Liverpool bank is illustrated in the "Encyclopædia Britannica" under Art Metal Work.

In conclusion, I have to express my thanks to Sir George Birdwood, our Chairman, for his kindly introduction, to Mr. William Reid, of Lauriston Castle, Midlothian, who obtained for me during his recent tour in Italy the illustrations you have seen, and to Lady Theodora Guest for most kindly translating the descriptions of the gates, which I have made use of, from the original Italian.

DISCUSSION.

The CHAIRMAN said that deeply grateful as they must all be to Mr. Starkie Gardner for his learned and most inspiring paper, and, he must add, most illuminative lantern slide "demonstrations," he was himself under a special obligation to Mr. Starkie Gardner. He had for over twelve years been seeking for a paper to be read in the Applied Art Section of the Society of Arts in continuation of the paper given by Mr. Starkie Gardner eighteen years ago on bronze work; but he had sought for it in vain until this year he found that Mr. Starkie Gardner was prepared to read a second paper on the subject provided that he himself undertook to occupy the chair on the occasion. In justice to himself he must add that when he consented to do this it was on the understanding that Mr. Starkie Gardner would treat of bronze work with the special object of promoting a revival of the ancient use of bronze in jewelry; and

he never anticipated that Mr. Starkie Gardner would devote his paper to an erudite exposition and an eloquent eulogy of bronze in its application to monumental statuary and architectural decoration. He had a natural feeling for applied art, and he hoped a sound judgment on it—in its more homely and familiar departments—and for sixty years he had with more or less responsibility given himself up to the study of its commercial and literary history; but he knew nothing of the so discriminated "fine arts," and he therefore felt himself in something of a false position in filling the chair that evening. It was not for him, he felt, to look up into the face of "the blue-eyed Maid," whose content it was to bow himself humbly down to the shadow of the latchet of of her "beautiful shoes,—ambrosial and golden" [*kala pedila, ambrosia, chruseia*, Od: xxiv., 340-1]. But as one of the general audience he had appreciated Mr. Starkie Gardner's paper as gratefully as anyone present, and in that sense no one was better qualified than himself to convey to Mr. Starkie Gardner the expression of their most hearty thanks for the charmed hour of instruction and delight they had all been privileged to pass with him. He would call on others to speak on Mr. Starkie Gardner's paper from the author's own standpoint; and all he himself proposed to do was to supplement Mr. Starkie Gardner's paper with a summary explanation of the etymologies of the words copper, bronze, and brass, for such explanations often throw much light on the earlier, unwritten history,—the pre-history,—of the industrial arts; and an equally brief reference to the copper, bronze, and brass work of India,—India of the Hindus,—as this would be found full of unexpected significancies not only for workers in the great metallurgical handicrafts, but also for the students of sacred iconography and doctrine and ritual. Brass, the alloy of copper with zinc, although said by some to have been unknown to the Greeks and Romans [who, however, probably used it as familiarly as the Hindus have always done, and in common with bronze], bears in the name by which we discriminate it from bronze the stamp of its high antiquity, the word "brass" being the Icelandic *bras*, "solder," from *brasa*, "to (harden with) fire" [compare "braze," "brazier," &c.], cognate with the Sanskrit *brajj*, "to burn," "roast," "fry." Bronze, the alloy of copper with tin, has been known from the first use of copper in Egypt, Assyria, India, Greece, the world of Rome, &c.; but the word "bronze" is not older than the sixteenth century, being the Italian *bronzo* [received by us through the French *bronse*], "scorched," remotely cognate with "brown," "bruin," *i e.*, the *brown* bear, "burnt," burnish, brew, and more remotely with brass." The etymology of the word copper is more concisely traceable forwardly than backwardly:—Sanskrit *ayas*, "copper," then "metal," and, finally, in the form of *kala-ayas*, "iron," *i.e*, "black copper," [compare Homer's frequent *chalkos aithops*, "black copper," *i.e.*, "bronze," and *chalkos eruthros*, Iliad ix., 365, "red," *i.e.*, "native, copper"], and *loha*, "copper," but now exclusively "iron" [*pitala*, literally "bile-coloured copper," now signifying enclusively "brass]"; Old Persian *ayan*, "copper," then "iron," *ayan-hæna*, "metallic," literally "made of copper," or "made of iron," *ayokshusta*, "molten copper" [compare Greek *chalkos*, and also Semitic *nchoset*, Chaldee *nechaseh*, Syraic *nechosch*, Arabic *nuhas*, and the "Nehustan" of 2 Kings xviii. 4 = "Brummagem"]; Umbrian *ahenum*, "copper," and Latin *ahenum*, "a copper" cauldron ["caldron" being the Latin "caldaria," French *chaudiere*, but compare Greek *chalkos*] "aenus" "copper coloured," "signum aeneum," "a bronze statue"; and again "æs Cyprium," "Cyprian copper," *i.e.*, bronze or brass, in Low Latin "cuprum," "copper"; [compare "*gopper*-wood," of Genesis vi. 14, which if correctly identified with "Cypress," means "Cyprian-wood"], and Gothic *ais*, "copper," German *eisen*, "iron," Anglo-Saxon *iren*, "iron," and English "harness," "era," "ore," "iron," and again from the Low Latin, "cuprum," "copper," the Spanish and Portuguese *cobre*, French *cuivre*, German *kupfer*, and Dutch *koper*. It is generally assumed that the metallurgy of copper originated in pre-Semitic Assyria, and the Sumiro-Akkadian for copper, *urudu*, "fiery red," cannot but be connected with the Latin "raudus," "'slug'-copper," and "rudis," "rough," "unwrought," "unformed," "untilled," "rude"; and with the Baluchi and Old Persian *rod*, and Modern Persian *roi*, "copper"; and the Greek *eruthros* "red." But in a Sumiro-Akkadian hymn to the God-Smith of copper [*urudu*] and tin [*anak*] he is addressed [compare Tubal-Cain, Genesis iv., 22] as *Gibil*, a name resembling the Albanian *jebjiti*, literally an Egyptian [compare Gipsey], but meaning a "smith," and suggestive of the possibility of the Sumiro-Akkadians having acquired their knowledge of copper, and the art of working it, from Egypt. Certainly the Egyptians were acquainted with copper [*chomt*] from the earliest period of their Pharaonic history; while it would appear equally certain, from the etymologies above given, that it was through Asia, and not directly from Egypt, that the Aryan races of Europe acquired their earliest knowledge of copper. How primitive man came to discover copper and the other metals, and to use copper and iron for arms, implements, and utensils, is told by Lucretius [v., 1250-5] and Horace [Sat.: I., 3] with a vividness of detail the accuracy of which has been confirmed by the researches of modern ethnographers. The xxxivth Book of Pliny's Natural History is "the classical place" for an account of the monumental use of copper, by the Greeks and Romans; and it is a truly wonderful bequest to every student of the history of "the fine arts," for he therein enumerates 366 artists, with their most celebrated works in brass and bronze. In India there is no end of the store of copper and brass domestic utensils; while the treasure of brazen vessels and lamps,

and other sacred furniture, and of sacrificial implements in the temples is infinite; and the use of copper, and bronze, and brass for images of the gods is absolutely prodigious; and much is used also on some temples for the adorning of the panels of the folding doors, and their jambs and lintels, and thresholds, and of the clustered columns, and the bold architraves they upbear. The ring of the coppersmith's hammer, as sonorous and clear as the echoing note of the little green barbet [*Megalaima viridis*] called after him, cheers the weary wayfarer from every throbbing village of the upland steppes of the Deccan; and the clangorous coppersmiths' bazaar is always one of the most animated and inspiriting sights of the greater polytechnical cities of Western India. Wooden images of the gods are lawful only in the temples, and may not be used in private houses, and this may be the reply to Pliny's exclamation of wonder [xxxiv. 16 (7)], that notwithstanding the high antiquity of stone and metal statues of the gods in Italy, those in the temples were either of wood or earthenware. In India the clay images of the gods are worshipped both in temples and private houses, but they must be thrown into some sacred stream or tank after being once worshipped. Similarly, all domestic utensils of clay have to be broken into sherds by the Hindus after once using them. When the late Sir Henry Doulton first heard this statement in this very room, he sympathetically cried out:—"What a Paradise for the potter." Stone images, most of them black, but some white, are common in all temples, and may be set up also in private houses, but there they are usually of small and even minute size, and of crystal or precious stones. Images of all the gods [graven or molten] in all the metals, gold, silver, tin, quick-silver (with tin), copper, zinc, and lead, are also worshipped both in the temples and private houses; but only the images of the wives of the gods are of gold, as of Saraswati the wife of Brahma, "The Lord Creator"; Kali the wife of Shiva, "The Lord Destroyer"; Lakshmi the wife of Vishnu, "The Lord Preserver"; and Radha the mistress of Krishna, "The Lord of the Joy in Life"; and this is because these goddesses are the representatives of the highest glory and praise of the gods. All the images of the gods must be of a polished, or sparkling, or resplendent surface, or be brightly painted. [Compare Pausanias ii., 2.5, vii. 26.11, and vii. 39.6.] They must always shine, if only in their names, just as the Roman god of war shines in his name of "bright" Mars; and this explains the use of marble [Latin "marmor," and Greek *mar-mar os* "the doubly," "the pre-eminently shining stone,"] in the divine imagery of the gods of Greece and Rome. The standard lamps of the Hindu temples built up in a conventional similitude to trees in full foliage, and laden with flowers or fruits, are truly glorious objects to look upon at the hour of evening service ["Hymnus ad incensum Lucernæ"], when all their fruits or flowers are lighted up, and the whole tree quivers into the light as of its own irradiant life. Such was the candelabrum Alexander the Great took away from the sacking of Thebes and dedicated to the Temple of the Palatine Apollo at Cyme [Pliny xxxiv. 8 (3)]. Mr. Starkie Gardner's paper was obviously pertinent to the actualities and interests of a moment when Londoners were awakening to the duty of rendering their city,—"this God Protected, wonderful Tree of Life," as a former Sultan of Zanzibar, Seyyid Bargasch, phrased it while here in 1875—more worthy, in the "setting out" and architecture of its reconstructing streets and squares, of its place of authority and pride in the history of these islands. The most spacious, the most commodious, the most populous, and the most opulent of the marts of merchandise yet known to man, by its free hospitality toward "all they who go down to the sea in ships, and do business on great waters," even more than by its natural opportunities of position, London has during the past thousand years become the centre of the traffics, and drawn to itself the trade and wealth—"the peaceful commerce from divisible shores"—of the whole habitable globe; and Mr. Starkie Gardner's paper in its motive and expression was another impressive warning that the critical time has arrived, and cannot longer, with any safety, be procrastinated, for a determinate, sustained, and conclusive effort to make this the most famous of modern cities, also the most stately and beautiful; and a pre-eminent, exemplary, and imperishable symbol of the genius, achievements, and renown of the English speaking peoples, not only of the United Kingdom, but settled throughout the world in all their several States, Dominions, Commonwealths, and Confederations. This was the immediate purpose of Mr. Starkie Gardner's paper, to which he—the Chairman—would desire to direct the attention of those who followed him in the discussion on it.

Mr. HUGH STANNUS thought the paper was one of the most interesting which had been delivered before the Applied Art Section of the Society, illustrated as it had been by so fine a collection of lantern slides. It was possible to deal with the subject from three points of view—the technical, the æsthetic, or that of storiation. A man might speak of bronze, with reference to its alloys, and the method of working, which would be its technical side; or he might speak of it, having reference to its qualities, as fine art, which would be the æsthetic side; or he might speak of it in reference to the story it had to tell to the people who looked upon it in all years, which was the storiation side of the subject. He was very much interested to notice how much attention the author gave to the last. Bronze, by reason of its being so noble a metal, and having the power of permanence, lent itself especially to telling a story to those who came after. The author had spoken very feelingly about the unfortunate manner in which the important spaces at the intersection of main thoroughfares were

desecrated by institutions which though useful might very well be placed in less conspicuous positions. While the author was speaking on the subject, he was reminded of the decorative treatment at the crossing of four streets in the City of Rome. Mr. Gardner would recollect the street which runs from the Pincian Hill to the Santa Maria Maggiore, which is crossed by the Via del Quirinale, four pieces of sculpture on fountains being placed at the corners, the street hence being called Via Quattro Fontane. He supposed that in modern mercantile days people would object to putting up fountains which would waste space that might be occupied by shop windows; but they had a very monumental effect in Rome, and it was well worth considering whether treatments of the same nature could not be carried out in London. The author had referred to Blackfriars and Westminster bridges, and had stated that people realised the importance of decorating bridges as well as building them. Blackfriars-bridge was designed with pedestals for groups of sculpture, and Westminster-bridge was not; and by that curious method of doing what ought not to be done, and leaving undone that which ought to have been done, a group of sculpture had been placed at Westminster, whilst Blackfriars-bridge remained tenantless, so far as its pedestals were concerned. With reference to the statuary for Blackfriars, he was reminded of the competition which was held many years ago for designs for sculpture to occupy the four large blocks of pedestals. Judges were appointed, who went about their work in the wrong way. The competition was for *designs* and not for *modelling* only; but the judges awarded the competition entirely for the modelling, the result being that the competition was a fiasco. Among the designs sent in were some which would have been good for the spaces, but the prizes were given to modelled equestrian statues. The Boadicea on Westminster-bridge was a fine piece of work, but he would like to see that piece of sculpture applied to Blackfriars rather than to Westminster-bridge. The author had referred to the ivory, the gold, and the mixing of the various materials in polychromatic statuary. He submitted for Mr. Gardner's consideration whether those materials were not intended for protected statues which were placed indoors. They read of the chryselephantine statue in the Parthenon, and the chryselephantine statue to Zeus at Olympia; but the mixing of the various materials would leave joints or crevices between the joinings of the materials which made them unsuitable for outdoor statues. As the author had so admirably said, the Greeks had not that objection to colour that people in Puritan England seemed to have, and they therefore mixed not only marble, ivory, and metals, but also enamels in a very delightful manner. The author had also referred to Gates and Doors, and had shown a very fine series of slides which must have involved an enormous amount of collection. He thought the thanks of the members were particularly due to the author for his admirable illustrations, and his remarks upon them. He was reminded of two designs for doors by British artists, the first of which had not been carried out, but the drawings of which were at South Kensington, namely, the design for the doors of the Geological Museum in Piccadilly, which he included in the illustrations of his Book on Stevens. Happily the designs and models of a pupil of Stevens for another pair of doors had been executed, and were at the South Kensington Museum, serving as the doors from the Quadrangle to the Refreshment Corridor. Small as they were, they were admirable in style. He would like to contest Mr. Gardner's complaint as to the time taken by the Italian artists. First of all, he submitted there was no authority for supposing that the gates designed either by Ghiberti or Pisano were their *exclusive* occupation during the 20, 22, or 27 years upon which the author had commented. Those artists might have had other commissions on hand, indeed it was extremely likely they had. And, when one read, for instance, in the Biography of Cellini, of the manner in which the artist's time in those days was cut to waste by his noble patrons, he thought they should have a good deal of sympathy with the artists. He knew of a modern monument in St. Paul's Cathedral which took something like 20 years to complete. If it took 20 years to complete the central Ghiberti gates, they were well worth waiting for. In conclusion, he could not help feeling that the author had touched on only the fringe of the subject, and what was really needed was not a solitary paper but a Course of Lectures which would give material for a future hand-book on the subject.

Mr. S. B. GOSLIN said the subject of the paper was very interesting to him because bronze founding was his everyday occupation. He thought the apathy of the British public towards bronze founding was attributable to two facts, firstly, that the Founders' Company, to which both Mr. Stannus and himself belonged, did nothing whatever to foster the art in London or in England. He thought it was time the Founders' Company altered their course of procedure. An Exhibition was held a few years ago of what was supposed to be British or London founding, and it was a great difficulty for the Master and Wardens at the time to find sufficient specimens to make an exhibition. He believed the Exhibition passed off with the usual lunch, and nothing had been heard of British founding since. In walking past the School of Trades in Cleveland-street, near the Middlesex Hospital, he anxiously looked down the list of subjects on which instruction was given to workmen to see if founding was among the subjects taught; but although carpentry, masonry, bricklaying, and sheet metal work were taught, founding was not. It was not to be wondered at that the art of bronze founding did not advance when so little was done for it in this country at the present time. Since the cessation of the Boer war, however, he had been astounded to receive so many enquiries

for all sorts of articles in bronze, such as monumental tablets, figures, and ornaments. He supposed that at no previous time within the history of the country had there been such a demand for bronze work connected with monuments as there had been since the Boer war. A variety of designs for figures, tablets, and ornaments had been placed before him, and he knew that several of them had been excellently carried out. It seemed to him that at the present time people were really waking up to the fact that bronze ornaments were the most suitable in this country for such work as the author had mentioned. Mr. Starkie Gardner had not mentioned in his paper anything about the bronze work carried out in the time of the Egyptians or the Israelites. It was his privilege a short time ago to be amongst some Jewish ministers who wished to decorate their synagogue at Stepney Green, East London, and he at once suggested to them that the columns of the synagogue should be decorated with bronze, as bronze had been freely used in Solomon's Temple. He was happy to say they fell in with the idea, and representations were placed on the columns of the synagogue of the fruits of the Holy Land, such as grapes, figs, olives, and so on. He had also made a great many mausoleum doors in bronze, all of the plain type, with one exception. He had recently been called upon to make a decorative mausoleum door, the model representing Christ as the Good Shepherd. It was now attached to a mausoleum in the cemetery of the Necropolis Company at Woking, and was much appreciated by many people who had been to see it. He was inclined to think that that style of decoration in monumental work would increase. He would like to ask the author whether the panels in the ancient Italian doors which had been shown were cast separately, and then put into the frame, or whether they were cast in one piece, and what was the thickness of the doors.

Mr. STARKIE GARDNER said they were all separate, but the other question he could not answer off-hand, but the thickness could be ascertained by comparing the weight with the size.

Mr. GOSLIN, continuing, said that probably one reason why the artists in ancient Italy spent so much time over their work might have been due to the fact that they had to make several castings before they obtained a perfect one, a large casting being so liable to warp when it was cooling. He remembered on one occasion he had to cast a large monumental tablet 8 ft. by 4 ft. 6 ins. for the cathedral at Madrid, and he had to make three castings before he obtained one which was anything like flat.

The CHAIRMAN stated that in the instances of the Indian doors to which he had referred the panels were all separate, and beaten. He suggested that Mr. Goslin should go and see the Indian doors, particularly the bronze ones, at South Kensington. Personally he did not see why Indian workmen should not be imported into this country to do this sort of work. It would wake our Trades Unionists up a little if they saw how much better the Indians could do such work.

Mr. CYRIL DAVENPORT stated that his sympathies were more with hammered work than cast work. There was no doubt that the bronze horses at Venice and the statue of Colleoni were the finest pieces of bronze work in the world, but the horses had hitherto been generally considered to have been cast. Mr. Gardner had stated they might be hammered, and if so they were the finest pieces of hammered work in existence. It was a curious thing, but he had ~~recently seen~~ at the St. Louis Exhibition, some Japanese hammered work, which was absolutely in the round, which showed that, strange as it might seem, the author's conclusion was quite possible. He presumed Mr. Gardner thought the bronze horses must have been hammered-up piece-meal, and soldered together in places, but the Japanese work was hammered-up from a flat sheet of iron. It was most remarkable work which he had not seen noticed anywhere.

The CHAIRMAN enquired if there were two sheets, one for each side.

Mr. CYRIL DAVENPORT replied that there was only one sheet. The ancient Greeks did some very wonderful work in bronze; they hammered up a few small pieces in the round, or very near it, but he never saw a piece of work anywhere which was of such marvellous technical skill as the figures in the round done by the modern Japanese, and if the Japanese could do it to-day the ancient Greeks might have been able to do it in former days. Mr. Gardner's statement was a very remarkable one, and was probably quite right, because to cast horses with the wonderful grace they had must have been excessively difficult. He agreed with the Chairman that there was a very large field indeed for bronze jewellery, but he hoped it would be hammered and not cast. Cast work might be made from a piece of hammered work, but in the hammered work one obtained the actual handiwork and skill of the artist, which was not the case with cast work unless it was chased over, as one of the wonderful doors which had been shown was.

Mr. E. R. ROBSON said the mention which had been made of the bronze horses at Venice recalled to his mind that some years ago he saw an equestrian statue, ostensibly of bronze, unveiled in the City of Durham; and as the sheet was drawn off the whole thing quivered. In subsequent conversation with the sculptor he enquired what the core of the statue was made of; and he ascertained that the film was only about one-eighth of an inch thick. He did not think the horses at Venice were entirely of wrought bronze; and it had occurred to him that if modern men thought about old methods there might be some old method by which the core could be made of

wax, which could afterwards be melted and got out, leaving the metal very thin indeed.

The CHAIRMAN, in proposing a vote of thanks to Mr. Starkie Gardner for his paper, said that beyond its technical value its literary merit also was higher, and he was sure it would always be referred to in the future by those who wished to deal with the same subject.

The resolution having been carried unanimously, Mr. Starkie Gardner briefly acknowledged the compliment, and the meeting terminated.

Mr. STARKIE GARDNER writes:—I should like to add that some of the bronze statues of Greece, in their best period, were hammered out of sheet, and not cast. Two remarkable monuments I should have alluded to, though they no longer exist, were the Umbilicus Romæ, marking the centre of the empire, near the Roman Forum, a cone-like structure of three stages of stone carved in a network of metal. This, perhaps, reproduced the sacred omphalos at Delphi. A central monument of the kind might well occupy the centre of the wide end of Parliament-street. The other was the Milliarium Aureum, a gilt bronze pillar set up by Augustus, with the names and distances of the gates of Rome from the central point, and the chief towns on the roads which radiated from Rome. Charing-cross suggests itself as the site for such a monument.

TWENTIETH ORDINARY MEETING.

Wednesday, May 10, 1905; J. CATHCART WASON, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Bodie, Samuel Murphy, D.Sc., Macduff, N.B.
Drury, Henry George, M.V.O., St. Oswald's, Downs-road, Clapton, N.E.
Eldred, Byron L., 208, Fifth-avenue, New York City, U.S.A.
Garside, Alfred B., 1a, Dennington-park-mansions, West Hampstead, N.W.
Harvey, Frank E., British India Marine Service Club, Hastings-street, Calcutta, India.
Moore, Miss Esther M., 4, Bath-road, Bedford-park, Chiswick, W.
Noble, Mrs. G. J. W., 47, South-street, Park-lane, W.
Peattie, M. M. A., 35, High-street, Oxford.
Playter, Franklin, 6, Beacon-street, Boston, Massachusetts, U.S.A.
Short, Ernest Angelo, care of Messrs. H. S. King and Co., 9, Pall-mall, S.W.
Smith-Rewse, Colonel Henry Whistler, R.E., C.V.O., Brompton-barracks, Chatham.
West, Chas. A. W., P.O.A. Kafferstadt, Harrismith District, Orange River Colony, South Africa.
Whitehead, Ernest William, Twyneham, Queen's-road, Wimbledon.

The following candidates were ballotted for and duly elected members of the Society:—

Cole, Dr. J. W. E., Mwomboshi River, North-eastern Rhodesia, South Africa.
Hall, William Henry, Statistical Department, Sydney, New South Wales, Australia.
Hawdon, Joseph William, 16, Windsor-road, Denmark-hill, S.E.
Kiralfy, Imre, Tower-house, Cromwell-road, S.W.
Longden, Henry, 447, Oxford-street, W.
Meintjes, Laurens Schmitz, African Farms, Ltd., Maribogo Station, British Bechuanaland, South Africa.
Moore, James, 17, Donegall-place, Belfast, and The Finaghy, Balmoral, Belfast.
Newcomen, A. Gleadowe, Messrs. Cooper, Allen and Co., Cawnpore, India, and Messrs. Allen Bros. and Co., 14, Devonshire-square, E.C.
Parker, Walter Edward, A.M., 217, Haverhill-street, Lawrence, Massachusetts, U.S.A.
Tilley, James Walter, F.C.S., 95A, Southwark-street, S.E.
Weeks, Rufus Wells, "Devonbrink," Tarrytown, New York, U.S.A.

The paper read was—

THE NATIVE RACES OF THE UNKNOWN HEART OF CENTRAL AFRICA.

By VISCOUNT MOUNTMORRES.

I take it for granted that everyone present is aware roughly of the geography of Central Africa, that is to say, the course of the two main rivers which traverse it, the Congo and its large northern tributary, the Ubangi. The course I followed in my recent journey was that I entered on the west coast side, went up the Congo as far as its junction with the Ubangi, then followed the Ubangi north up to the fifth parallel of latitude, and then made my way back overland by a semicircle down to the Congo again as far as Stanley Falls. From there I struck out east across to the Uganda border, and came back down the Aruwimi and the Ituri to the Congo again, crossed it, and came back in a direct line along the length of the equator. During this journey I traversed one part at least that no

other white man had crossed, the country between the Ubangi and the Ituri, and in several parts I was the only man, other than the officials of the French or Belgian Governments, that had visited them. I came across races which astounded me with the very high degree of civilisation and development which they had attained to. Many of these races have a civilisation which is wholly and absolutely indigenous; they have learned nothing from the white man, because they have not as yet been brought in contact with him and, so far as is known historically, there has been no Arab influence brought to bear on them in the past. The people met with in the lower and middle Congo are fairly well known to every student of ethnology in this country. I think the only race of interest that I met with on my journey up-country was where I touched at Irebu, and made a journey round Lac Tumba, a large lake lying to the east of the point where the Congo runs nearly due north. There I found for the first time members of that vast tribe the Mongo, who furnish the principal inhabitants of the great equatorial forests. As is almost invariably the case, one finds that the forest dwellers are a low and less-developed type than the inhabitants of the plains and mountains which surround the forest, the fact being that in the course of time the weaker races have all been driven into the shelter of the forest by the sturdier races who have taken the better lands outside. And so you find that on the extreme north, lying between Lake Chad and the Ubangi, there is a sturdy, well-developed, virile race, whilst in the forest there are these undeveloped, backward people; and south of the forest, in the Kasai region and immediately north of Rhodesia, there is a sturdy, energetic, well-developed and comparatively civilised people. A curious thing is that these people to the north and to the south of the great equatorial forest have many traits in common. There is a close resemblance, for instance, between the Banza and Banziri people to the extreme north and the Kasai tribes to the extreme south, and the only explanation one can think of is that probably at some time there was a great movement of the Bantu people from the north, who, to all intents and purposes, completely surrounded the forest, when spreading out eastwards they struck the point where the Congo makes its extreme curve to the north; they avoided the forest, followed the course of the Congo round to the east, and came to the south, driving the original inhabitants into the security and shelter of the forest. It is of these more highly-developed races that I am going to speak, but just to give you an idea of what the forest-dwellers are like, and the way in which they live, I will begin by describing a Congo village.

The slide gives you a very typical scene in a Congo village. The huts, as a rule, are built in a continuons line along so-called streets, really large clearings. Instead of having any definite plantations, as a rule the bananas and plantains and even the tubers are set in the middle of these streets. The people themselves are not over clean, which is a remarkable thing to find among people who, on the whole, are remarkable for their cleanliness. Most of the natives of Central Africa are exceptionally cleanly in their habits and careful of their personal appearance. The Congo people, on the other hand, are on the whole an indolent race, and take very little care of their personal appearance; but every now and then an energetic chief takes the trouble to improve his village, and that was the case at Mwangi. The slide just shown was an old part of the village, unimproved, as it existed certainly for almost countless ages; in the other part, where this present energetic chief has set to work to rebuild it, you see quite a neat, clean row of well-constructed huts, each of which is provided with a little sliding door, and able to accommodate one person. As a rule in these villages the husband, the head of the family, lives in a hut at the end of the street, each of his wives having a hut to herself, the next hut to it containing her waiting woman or slave. In the photograph the occupants of a group of huts are seen sitting outside, as they do almost all day long, sunning themselves, and waiting for Nature to supply them with their few and scanty needs.

In this slide you have another view of the way in which the women sit all day long doing nothing practically. All they have to do is to wait for the bananas which they plant to grow up and ripen, and then pick them off and eat them. Beyond their food, and the necessity of building themselves shelter against the rainy season, the natives have practically no needs to satisfy, as a bountiful Nature supplies them with everything.

The next slide shows you the chief himself in a gathering in front of the hut I occupied. This is Mwangi, who has taken to European dress. He comes very frequently into

Trebu, the white station, and nothing pleases him so much as the gift of a pair of sand shoes, or an old white coat. On this occasion I think he had on three different coats, one over the other. Another white man who was staying there gave him one, I gave him one, and he had one to start with, and it was amusing to see him going out with these coats flapping in the breeze as he walked along.

The next slide is a photograph of another native who is chief of a small village abutting on the other; he is known to the white men all round that district by the name of "Britannia," due to the fact that he goes about in a costume closely resembling that of the lady who sits on the back of the British penny. He invariably carries a spear, and evidently has been told of the lady on the back of a penny, or has had a penny shown him, for whenever he comes to rest he always assumes the attitude of Britannia.

Leaving Trebu, I went, as I have said, up the Ubangi, and I found at one of the white stations there one of the largest cemeteries for natives that I have seen in Africa. All the natives in Africa have different methods of burial, some of which are highly insanitary, consisting very often of throwing the bodies into the river. A great deal has been done in organising and persuading the natives to bury their dead in regular burial grounds, and the natives take considerable care of their burial grounds in some parts. In this particular case there was a large number of graves, all of which were covered with the personal appliances that were necessary during the life of the native who was buried there. There were cooking utensils, lengths of cloth, in many cases a large tin trunk, and various other objects distributed on the graves. Each one of these objects, whatever its nature, was damaged beyond repair, the natives saying the reason for this being to prevent the evil spirits from coming and making use of them, but I rather fancy it is to prevent the less orderly of their fellow-tribesmen from coming and stealing them and making use of them. At any rate, it is the invariable custom to damage the articles that are put on the graves. In other parts of Central Africa I came across graves on which it was the habit for every passer-by to contribute some article, usually of food. Whenever a white man went past it was the custom for him to throw a cigarette or a cigar on the grave, and one could tell from the number of such cigars and cigarettes exactly how many white men had been along that route. The graves in this part were beautifully kept up; everything deposited on them was left untouched, and there was no need to damage the things. All the little cooking utensils were kept at one end, the food supply at the other, and when the food decayed it was swept away as having been consumed by the spirit of the dead man on his journey to the other world.

On the Lower Ubangi there is an extraordinary mixture of races, and one's task in trying to unravel their exact relationship is made all the more difficult by the fact that there is no very general agreement as to their names. You find tribes entirely different called by the same names by different authorities. For instance, the tribe of which you see a picture is the Sango tribe, which are called by other writers the Dongo tribe, while the people who are called the Dongo by one set of writers are called the Budja tribe by another set of writers. So you find, if you try to gain any information from works on these races, it is practically impossible to do so, and all one can do is to start on one's own and distinguish the people by the traits found existing amongst them. Whatever we like to call this race I should say probably that it is an offshoot of the great Bangala race which inhabit the northern bank of the Congo, and has penetrated up to the Ubangi. My reason for believing that is, first of all, the character of the buildings. They build their villages round little squares, very neatly, and without any ornamentation—a perfectly simple group of huts round a little square, which opens into the next by a straight alley-way, so that you can look down the central lane; and, as you walk along it, off each side open a series of little court-yards with huts all round them. Another thing is the shape of their heads. They are all very wide-headed people and very finely built, except their legs. They are all rather weedy in the legs, but they have wide shoulders, obviously bespeaking a nation of paddlers in the habit of living in canoes and paddling a great deal. Another thing is that you get for the first time in this people what is generally called the Sango tattooage.

The next slide is a photograph of the chief of the village of Imesse, a large village close to the white post of which you saw the cemetery just now. You will see here that the tattooage of the Sango people consists of three little lumps raised on the forehead. On the lower Ubangi only one little nob is raised on the forehead just

between the eyes. As you get farther up you get to three nobs, and with those three nobs all kinds of additions, according to the sub-tribes to which the people belong.

The next slide shows you another feature in reference to the buildings of the peoples of Imesse. One reason why I think this tribe is closely attached to the Bangala tribe is that their huts are all palm thatched. There is a great division between the palm thatchers and the grass thatchers. Of course the explanation is one of locality in the first instance, but you will find that the palm thatchers in a neighbourhood of grass land still go to great trouble to thatch their huts with palm leaves, although they have plenty of grass round them; and *vice-versá*, the grass thatchers, when they live in the forests or in a thick scrub, will go to immense distances to fetch grass to thatch their huts. So that the distinction, although originally undoubtedly one of the facilities of the localities in which the natives found themselves, is no longer so, but rather a tribal distinction. Again, the Bangala people almost invariably, after the thatching of their hut is complete, in order to prevent its being carried away by the tremendous tornadoes on the Equator in the immediate district in which they live, have been in the habit, for many generations probably, of covering their roofs with little transverse bars which hold the grass in place. That is a thing one looks out for as a characteristic of these tribes. You find in a district where tornadoes are not severe that this peculiarity of covering the roofs with transverse pieces of stick, held in place by the weight of enormous full-length trees, still prevails, although probably there is no actual need for it.

There are also the typical Bangala chairs made out of trees which are cut and stuck in the ground, and which have certain very definite and regular shapes. A particular shaped fork is sought after, and you will find in one village perhaps dozens of that particular shaped fork until you begin to wonder how on earth so many similar forks could have been found in the neighbourhood. In another village you will find another pattern prevailing. The type shown in the slide is set up on end, with a seat, as it were, for the person to sit in. That is the Bangala pattern. When you get a little further up it is merely a back rest; the occupant of the chair sits on the ground, and leans on the back rest, with two forks to support his arms. The next slide shows you a little advance on the last, in that you have the typical dress of the Bangala, the ballet skirt as it is called. It is quite true that it has spread from the Bangala people to many other tribes, especially to those just a little further north of these people, but the people round Imisse invariably wear them, whereas in other parts it is only a very smart lady who has advanced to this degree. She has copied from her neighbours, much as we in England copy from France. The native women are almost invariably devoted with an extreme attachment to their children, and whilst many of them will go without bangles and armlets you will invariably find that their children are laden with every form of crude and barbaric ornament that they can possibly possess.

In the photograph you will see that the woman has no ornaments, whilst the child is absolutely laden with them; his little black curly hair is plaited into tiny plaits and ornamented with pieces of ivory, boar's teeth, and beads, in fact anything that will decorate and ornament it. I took about four photographs of this child in order to try and get a view of its face, because it was one of the very few really pretty native children I saw; but every time I was going to take the photograph and asked the child to keep still, in a natural fright it turned away and snuggled against its mother, so that I could not obtain a full-faced view. The next photograph shows you a palm-thatched house, and we can conclude from that that it is inhabited by some near relationships to the people we last saw. It has not, however, the transverse bars. You find that suddenly you come across a people amongst whom it is the custom for every free woman, as soon as she gets to marriageable age (which out there is about eight or nine years of age), to wear an enormous brass or copper collar round her neck, which weighs many pounds, and which is forged on to her neck. Quite a ceremony is performed when this collar is forged on, and it can only be removed by removing the head of the wearer first. The collars are worn practically from childhood until death, and as they are never removed day or night, the wearers sleep in a pillow hollowed out to support the head, leaving the collar free. Very often it causes large sores and abscesses on the shoulders, but the people never think of discarding the collar. It is a very marked characteristic of these people; but you find immediately after passing the group of villages in which this photograph

was taken this particular characteristic disappears again as suddenly as it appears. This is really a Dongo village which has pushed its way down to the river bank, although the majority of the Dongos are agricultural people who inhabit the interior. This particular village, which is called Dongo —very often villages are called by the tribal name—is one of the largest native conglomerations that I came across. It has a population that cannot be less than 7,000. During two days I took the utmost pains to try and verify exactly its population by various means. I counted the huts, the wives, the children who were too young to work, and used various other means, and I came to the conclusion that 7,000 was a good deal below the actual figure—I think probably there must have been close on 10,000 in this one town of Dongo.

In the next photograph you can see more plainly that these are distinctly palm-thatched roofs. The women are in the typical dress; they still wear the Bangala ballet skirt, but this woman has added a little apron of string, and wears the big characteristic collar, which is a kind of dog collar, open in front, the edges being rolled immediately under the chin to hold the head up, and all round it, beaten on to it, is a supporting rib which prevents it being opened once it has been forged on. It gives the woman a peculiarly graceful and dignified carriage, but it is certainly very uncomfortable.

The last photograph shows you the chief's daughter. Dongo himself, when I visited the town, was absent, hunting in the interior, and his daughter entertained us and showed us about. Another free woman of the place is also to be seen, and you will notice the enormous quantities of bangles that the women wear. They wear a number of brass rings, carefully graduated, the smallest of them weighing probably not less than 1¼ lbs., and the largest from 2½ lbs. to 3 lbs. You can imagine, therefore, the weight they have to carry about on their arms, and the intrinsic value of these rings, for which the brass has been imported at some time from white men. It has made its way slowly up the river, passing probably through hundreds and hundreds of hands before it reaches its final destination. In that part of the world transport is the principal item of cost, and the intrinsic value of these brass bangles to the native is enormous. I asked one woman how many brass rods she calculated went to make the collar she was wearing and she told me—(and I think she was probably right; one can verify it fairly accurately by knowing roughly the weight of the collar)—about 6,000 rods, which represented a value in English money of a little under £20 for that one collar. That means to say that out there to the native woman it was a very large fortune indeed; in fact the womenkind carry their fortune on their backs undoubtedly. The fortune of the men is the number of their wives. When a man gets rich he buys more wives; when he gets poor he sells them again.

The next slide shows some of the warriors of the village of Dongo. One peculiarity of Dongo, which makes it almost certain that it belongs to the tribe which is generally recognised by that name, is this, that it is very exactly divided into three distinct wards, the inhabitants being separated by a kind of caste distinction. I believe that the Dongo are the only people amongst whom this caste distinction exists in Central Africa. Everywhere the forging of metals is either an object of veneration or an object of disgust and loathing; it either represents the highest type of labour in a village or the lowest. That is the only other instance in Central Africa of anything approaching to caste; but in Dongo, and in all Dongo villages, the villages are distinctly divided into three parts. One part represents the labourers—in this case, being a river village, the fishing people, who devote themselves to providing nourishment for themselves and the villagers, and for trading purposes with the interior. The second section are the manufacturers, the workers in metal, and the makers of cloth and pottery, in fact, all the textile manufactures of native life. The third section are the warriors. The men are armed with enormously long spears, about 9 feet 6 inches or 10 feet in length, and they are very skilful in throwing them. Their other arms consist of large-handled knives, in ornamental scabbards, bound with copper wire. They are protected not only by their shield, but by a strange kind of cuirass made out of buffalo hide. It is slung on the shoulders and protects their back and spear arm, the right, so that in that way they are practically safeguarded against attack by native weapons. The Dongo are a people who have reached a considerable degree of development, both in arts and manufactures.

The next picture shows a group of natives who were waiting our arrival at the village of Dongo. At first we were rather doubtful of

them, because we were informed that the only white man who had, in recent times, visited the village, a missionary, had been eaten, and had not since been replaced. We felt a little timid, but they extended a most hearty and cheery welcome to us. The day I arrived there, a white man, who had marched across from the interior, an official of the Belgium Government, arrived in the village also, and before I left he was installed there as a representative of the State authority, and was on the most excellent terms with the chief's daughter, the chief being absent, but I have no doubt that on his return the Dongos would settle down to be law-abiding members of the community. And they ought to be, because their trade is very highly developed. They understand all the ordinary principles of interchange; for instance, the fishermen in this village exchange with the agriculturists in the interior, and the pottery, cloth, and metal work is exchanged for fruit and produce grown at other parts of the river.

As artists they have also advanced very far. The house of the chief is entirely ornamented with carved wood, a kind of ebony, which is not as hard but almost as black, and grows freely in this district. The wood is most highly polished, and ornamented with rude sculpture work and carving. On the front of many of the houses are panels, left plain, on which rough pictures are pencilled with burnt wood. The meaning and purpose of the drawings one could easily understand. How recently these people had been addicted to cannibalism was only too evident on the occasion of my visit, because at every street corner in the village there were one, two, three, or more human skulls half-buried in the ground, each of which represented a cannibal feast. It was their habit, when they had had a particularly cheerful evening in dining off some fattened slave, to half-bury the head, in order that it may recall the pleasant evening they had spent together. Some of these heads were quite newly interred; and I think there is no doubt that if one could arrive quite unexpectedly amongst the Dongo people, one might surprise them, even to this day, in the midst of a cannibal orgy. But, as I say, they are a people who will probably settle down, as many other savage people in this part have, to the ordinary principles of civilisation.

The next photograph shows a village in the transition stage, probably the last of the Dongo villages proper, where you see all the ladies still wear the collar but very few of them the Bangala skirt, which has not got as far as this place. Most of the roofs of the houses are palm thatched, but many of them you will notice are beginning to be grass thatched. It is a transition village, made up, no doubt, of members of different tribes who have left and intermarried. There is no doubt that cannibalism all along this part was very prevalent until quite recent times. One of the most extraordinary things is that almost everywhere I went, even where the white man himself has not been, or where he is little more than a legendary figure, the native is already ashamed of cannibalism, whereas in times past he was openly addicted to it. One old fellow told me that the meat of a white man was much better than the meat of a black man because it has a salt taste. All along the river we were greeted at every stopping place by large crowds, who used to come down to the water's edge to meet and cheer us. If ever we wanted paddlers there was no difficulty in finding them. At some places, for instance near Yakoma, the men were so energetic and keen to do the white man a service that they ran along the bank, leapt into the water, came swimming out to my canoe, and forcibly dispossessed my own paddlers of their paddles, throwing them into the water, and themselves took on the task of paddling; just as in this country the custom still exists in many parts on the return of a bride and bridegroom to unhorse the carriage and drag it along by human power. The idea underlying their action was exactly the same; they wished to show me honour, and the way they did it was to work for me and bring me themselves into their village. Their enthusiasm was very agreeable in its intent, but apt to be rather awkward and productive of unpleasant consequences in its execution, because the chances are that if you have 20 or 30 lusty savages climbing into a canoe and having a hand-to-hand scuffle with the canoe men, if the canoe is not swamped your belongings will get fairly wet.

The next photograph shows one of the groups that met us at the edge of a village belonging to another and quite distinct people, whose name I want you to distinguish from the name of the Zongo, namely, the Sango. You will see at once the difference in the villages. They are not built in squares but in long, perfectly straight lines, each debouching on the river. The people are entirely a riverine people; they live by fishing and paddling, and are not found in the in-

terior. One or two villages that have pushed into the interior are completely hidden in the dense bush, and the paths leading to them are skilfully disguised so that a stranger would not find them. They appear, as they have advanced into the interior, to have got shy and timid, whereas on the river bank, which is their domain, and in which they are in their element, they are nothing of the kind. They build large villages showing to the river, and on the approach of every canoe they come down to greet it, or, no doubt, if it is an enemy, to attack it. They are very far from a timid people when they are on the river bank. You will notice that nearly all the huts have the characteristic thatch I have mentioned; but in some villages it is wholly absent. As a rule you can tell a Sango the minute you see him by the three bumps, of which we saw the first signs in the Bangala people lower down the river. These villages are of enormous length but of no great depth, the object of each member of the population of a village being to be as near the river and the fishing as he possibly can be. These villages consequently extend along the river's edge sometimes for a matter of miles.

The next photograph shows you in detail the method of constructing the villages. It is the habit of these people never to move their villages bodily. When the ground on which they can grow crops is used up, or when the fishing has gone away from them, or when they want to improve their village they let one end fall into ruins and go on building at the other end. Before you come to a Sango village you come to a large clear space, with ruins of old huts in it, while at the other end the village is continually moved forward, through the bush, and no doubt that accounts in a very large measure for the very healthy condition of the tribe. As a rule the Sango people are fine in physique and exceedingly healthy, with very little disease. Their children especially are amongst the healthiest children that I saw. Most of the children of Central African races are subject to rickets; in fact, a large majority of them would do as examples, in a work on pathology, of typical cases of rickets. There is no doubt that the healthiness of the Sango people and their children is very largely due to the superior sanitation of their villages, owing to this constant process of moving which goes on amongst them.

The next slide shows you the way in which they build the huts like long sheds. The whole street is built from one end to the other; stakes are driven into the ground, bamboos or palm branches are stretched across to form the roofs, and transverse pieces are put on which are thatched with grass. The work requires a considerable amount of skill. The villages, which are laid out absolutely symmetrically, are exceedingly strong and well built, and the pace at which they are constructed is simply astounding. In this part of the country I spent two days in the interior, and stayed about a couple of days in the village itself, so that altogether I was there four or five days. From the time that I first saw the place, to when I left, the people had entirely constructed three of these long streets, that is to say, six rows of long sheds ready for thatching. Every joint in the huts is tied with little pieces of vine creeper, so that the detailed work is enormous, and yet they do it with a rapidity that could not be equalled by the ordinary European. It means that this particular form of labour has reached a very high stage of development.

Now we come, quite suddenly again, to an entirely different people. Here we break on the Upper Ubangi. The usual distinction between the Upper and Lower Ubangi is between the span-roofed huts and the beehive or conical huts, and here you have the beehive shape. These two photographs were taken within a day's paddling of one another; they show practically one set of villages running right up to the other set, and yet the distinction is complete. You never see a span-roofed hut in one of these villages, or one of the beehive huts in one of the span-roofed villages. You can therefore be absolutely certain that you have come to an entirely different and distinct people. That is borne out when you see the people themselves, because they are a wholly different race in every respect. In the first place, the type of countenance is different. You will notice that they are not, on the whole, bad-looking; they are nothing like as coarse-featured, for instance, as the Bangala, or Sango, or Dongo; they are a much higher type of race altogether, and much finer built, so far as their lower limbs are concerned. The feature that distinguishes them above all in their characteristics is that they are the most artistic of all races in Central Africa. They are the Banziri. Every man amongst them has his hair plaited into tiny plaits, with the smallest beads that he can obtain. The beads travel right across Africa

from tribe to tribe, from the nearest trading station of a white man. They plait these beads as a rule, red and blue, in a very artistic fashion into the hair, forming a complete cap, very often with long pieces hanging over the ears, and almost always with two little tablets hanging down in front. Nearly every man in the race does that with his hair. Then they have an extraordinary love for colour. Most of the races, especially those along the Ubangi, prefer dark maroon red or very dark blue. If you have a large selection of cloth, as you must have when you are travelling, you will find there is a great run on the dark reds and dark blues until you come amongst the Banziri, and then all the pieces which you had been despairing of being able to use at all, the light blues and greens and all the other gaudy colours are suddenly in great demand. Nothing pleases a woman so much as to have a long length of vivid red cloth to wrap round her body. One of the men shown in the photograph is probably a foreigner to the race, but he was dressed from head to foot in red. He was living amongst them, and no doubt had married into them. He had worked on a steamer on the lower river, and had earned enough money to buy himself a pair of pantaloons and a jersey, both of which were a vivid red, while his head was covered with a red covering made out of ordinary Turkey twill. The sight of this man dressed in red, with the women dressed in green, was extraordinary in the extreme, especially when one had been in a country where one had not seen a speck of bright colour before. The villages of the Banziri differ again in another respect from every village we had seen up to this point, viz., that there is no attempt at building them along streets—there is no mathematical symmetry about them at all. They are scattered about in the plantation, and very often, as you see in the photograph, they are almost hidden and smothered with trees. There are wide spaces between them, and very well-kept pretty little paths, trodden down by travel. Along both sides of the paths the grass grows freely, and the general effect is far more picturesque and attractive than those of the races that build long, straight streets. The same characteristic is true of the other kind of huts we came across—the conical huts. We see no more of the Banziri type for the time, but pass from the beehive hut to the conical hut. The conical hut varies enormously, and in its variations we distinguish the different tribes. For instance, there is the hut which is built straight from the ground; there is no attempt at a wall; it is all roof. The huts also vary very much in their height. But whereas in many parts there are no walls, in other parts there is a small wall and the roof springs from that. In others, again, the floor of the hut is raised to a considerable extent above the surrounding ground, and the walls are carried up above that again. So that there are half-a-dozen different varieties of these conical huts, each denoting a different tribe, but the conical hut as a whole denotes always the great Banza people. The Banza people are one of the largest groups in this part of Africa. The density of the population here is absolutely appalling. One passes all day long through a series of villages along the river banks. The villages are no longer the shallow villages of the Sango, but extend away into the interior as far as the eye can see. I went many days' march into the interior, and for the whole way one passes through a village, then the plantation, a little bit of open space, and, perhaps, after an hour's walk, there is another plantation and another big village, and so you go on, one village succeeding another in practically unbroken succession. Between Mokoangai and Banzyville, to all intents and purposes, it is one vast town the whole way along the shores of the river. These people live entirely on fish and on their crops. They have no chance of getting game, because it has been driven by this enormous population to such a distance from them. Altogether, unlike the Banziri lower down the river, who are a very sporting people, these people take no interest whatever in hunting, and are practically a non-hunting people. This is the result of their being town dwellers. Another result of dwelling in these large conglomerations is that all the industries have reached a high pitch of development, their iron, copper, and metal working more particularly. I saw some beautiful work being made in the forges in nearly all these villages. I watched and saw how it was made; and the skill that is displayed by the natives in the manufacture of elaborately chased and fretted knives, in binding handles in an ornamental fashion, and inlaying them with lizard skins, and generally turning out objects of beauty, is extraordinary. Their only appliances are, as a rule, a large stone for an anvil, and a smaller stone for a hammer, which is often enclosed in a creeper handle. Such a thing as a cold chisel in the way of a cutting instrument

is absolutely unknown, and the only cutting instrument they use is practically a soft iron instrument to cut the red-hot iron and fret it into patterns. You can imagine the time it would take to manufacture a knife in this way by anyone who is not highly skilled. While in one village which I visited, the chief, in order to do me honour, and seeing I was interested in the subject, ordered all his forges to start making patterns of spears and knives. I stayed with him him two nights and the intermediate day, and perhaps half the next day, and during that time the forges were going night and day, so the noise in the town was terrific. When I came to leave he called all the metal workers together, and they came bringing with them the result of their labours. I cannot guarantee that all the spears and knives were made during the time I was there, but they were presented to me as having been made during that time, and the total was 52 knives with large handles all beautifully ornamented, and 36 spears. Everyone of the spears was bound with copper wire, and inlaid with lizard skin at intervals, and the handles was beautifully carved. Even supposing that onlf half of them were made while I was there, it shows that these people have reached a degree of skill in metal working which I do not think could be equalled by white people unused to their primitive appliances. It is just the same in building; the skill they display and the pace at which they build their houses are simply extraordinary.

The next photograph shows we have now got into the wall stage. This is the beginning of the tribe of Baya, a large sub-division of the Banza people. You will notice a net hanging out to dry. These people along the river are most skilful in the manufacture of all appliances connected with the fishing industry. The fish nets and fish traps have reached an extraordinary perfection. The nets which are made on the lower Ubangi by less developed people are principally made out of creepers, the bark and tendrils of trees. A large square is made on a frame, and the tendrils are stretched backwards and forwards to form rude meshes. Some of them are knotted at the corners, while others, instead of being knotted are interlaced like a child's kindergarten map. But amongst these Banza the nets are almost wholly made of string, some of it plaited, some of it twisted; and some of the rope they make I should think must be as good as any rope made in the world. It is close twisted and very strong, and is made out of the grass which abounds in the neighbourhood. The nets are made of string, and all the meshes are knotted in very much the same way as an ordinary European net would be made. In addition to these nets, they use traps of all kinds, including a trap that is exactly similar in pattern to our lobster pot or eel trap. They are made in exactly the same way, and, from their appearance, might have been imported from Europe, although we know that is quite impossible in this locality. Another ingenious arrangement is the fishing platform or weir, which is constructed to support the lobster pot traps. On each side of some rapids two big poles are put up, connected by a cross pole; suspended from this by enormous creepers are the fish pots, which hang in the rapids. The whole of the structure can be tilted by pushing on the extreme end, so that the bar is tilted, and all the fish pots are swung ashore. When they have been emptied they are swung back again. It is one of the most ingenious contrivances I ever saw. Another arrangement is a weir, very much on the same principle as the weirs we use in this country, with rudely constructed water gates, which can be lifted up. A platform is built across the top on which a man can walk; he lets a tremendous flow of water into a particular channel, which is completely surrounded by a net; all the fish coming down from above are forced into the channel and pass into the net. This weir arrangement is, I believe, one of the most successful traps for catching fish, but it is only applicable to waters that are not used for the purposes of transport, and the consequence is it is only in the smaller streams it can be used.

The next slide shows a group of Baya people coming down to the water. You will notice that, for the most part, they are tattooed, but they have no distinctive tribal tattooage. One finds amongst the Banza people, as a whole, that there is a tribal tattooage, but amongst the Baya, which is simply a sub-division of them, the tattooage is almost entirely absent. At the most, it consists simply of a bit of the Banza tattooage; it is a large nob, which falls down in front from the middle of the forehead, a small nob above it, and a series of four nobs across the eye-brows. One or two of them, more particularly the women, go in for tattooing the shoulders. This tattooing is remarkable for the beauty of the designs at

which they have arrived. Many of them resemble very closely conventional designs taught in art schools in this country, and amongst others I came across was the regular *fleur de lis* of France enclosed in an empire frame-work. How it got there I do not know; it may have been brought in some cutting of a paper which somehow reached them, but it was so European that I do not believe it could have originated in the locality. It was exactly the same design as on the woman's arm in "The Three Musketeers." The tattooing is effected in the following manner:—The skin is cut, turned back and filled with a fibre extracted from between the bark and the main wood of a particular tree, which is pounded and dried; it is put into the wound, and the wound is then sown up over it. In course of time it suppurates, a little abcess forms, the flesh begins to hang down, and this wadding from inside forces its way out little by little. In one village at which I stopped on my way up-river, the medicine man, the tatooer, was then paying his annual or semi-annual visit, and all the boys in the place were undergoing tatooage. You can understand that the noise most of them made over it was considerable, though a large number of them bore the operation with extraordinary fortitude. This man, with an ordinary native knife, would cut three great gashes in the forehead; he would then put in the wadding, and draw the flesh over it, and with two bits of tendrils of creepers tie up the wound. It was then left alone; I suppose the patients would probably pass many weeks with these terrible festering sores on the face. In some places the natives are simply tattooed all over; the whole of the face and the body is one mass of tattooage. In this particular part the tattooage is strangely absent.

The next photograph shows the capital, Baya, itself. It is called a village, but it would be more accurate to call it a town divided into large wards. Over the whole town Baya, the chief, himself presides, a man who has been in his time much in contact with the white people, both in the French and Belgian colonies. He dresses in quite a Europeanised fashion and has introduced into his village many European methods. He is about two days' march from the nearest white post, and the town is extraordinary for the cleanliness that prevails there. You have amongst the whole of the Baya people another burying habit. When a man dies, if he is a big chief he is buried in his hut; if he is a chief of less importance, immediately outside the door of his hut; and in either of these two cases the hut is given up to the use of the dead man. But in the case of the ordinary private citizen of the village, he is buried some little distance in front of his hut. A regular family tomb is established, and little shelters are erected. A forked stick runs up at the corner on which are hung the various trophies of the chase, which are very highly prized because this is not a hunting or sporting people. The consequence is that if a man has killed any animals he keeps the trophies, just as a white man would keep them. Very often he decorates the top of his hut with them; for instance, if the native has shot an antelope with horns, he keeps them in front of his house, as you see in the photograph. When he dies all these things are hung on the branch at the corner of the tomb. Then there is a shelf on which are deposited all the spears, knives, warlike instruments, agricultural implements, and everything of that kind; and below that again are his domestic appliances, the calibashes in which he kept his palm oil, his palm wine and water. His cooking utensils of all kinds are stored there, and the members of his family keep up the tomb with a considerable amount of care. Very rarely a day passes but you will see one of the deceased's widows pottering about it, cleaning it up and setting it in order; in fact, one or other of them will generally devote her whole time to the upkeep of the tomb.

In this town one meets with every style of architecture. The dwelling-houses of the women always remain the same, a low-walled conical hut, but everything else in the village is built in a variety of styles that is puzzling. The photograph shows a house that was built, so I was assured, before the white man came to the nearest white post and before European influence could have been brought to bear upon the natives. It is a mud-built house, with a large wide verandah in front of it.

In all these villages there is not only the dwelling-house, but in front of it a day shelter in which the mankind sit and smoke and talk and generally pass their time. Most of these Baya people are energetic and industrious, but at the same time there is always a great part of the day in which they have nothing particular to do, and then they occupy their shelters. The shelters themselves are most picturesque buildings. You will see plainly

that they are all grass thatched, the one in the photograph having little minarets and spurs at each end. The roofs instead of being built perfectly symmetrically have a kind of waving edge at the two ends. The general effect of this town of Baya is exceedingly pretty.

The next photograph shows you how the influence of civilisation is making itself felt. Baya went and lived in the white post for about a month and watched the brickmakers at work. He came back to his village, and from what he had seen he started his people to make bricks, and to build a brick house. The photograph shows an enormous guest house in which he receives his visitors in quite ceremonious state, and the walls are built entirely of brick. Then he thought he would be more ambitious. He heard that in another white man's post, at the Dutch factory, about a fortnight's travel away, there was a two-storied house. He promptly started to build a two-storied house; but I am sorry to say that when the walls had just got above the first floor level they were so out of the true in some places that the bricks were falling off them as the mortar dried. He will probably never realise his ambition to build a two-storied house, but he was very successful in his first essay at brick building. This is interesting only as showing how quickly these people adapt themselves, because the whole of these people held out for a long time against the white man. In the middle of this village there is a little group, apparently of Banziri people, which I was absolutely unable to account for, living in beehive huts. There was a little strip of plantation in between. These towns are largely made up of groups of villages, completely shut off the one from the other. Two or three minutes' walk from the nearest hut in the Baya village there appears to be a Banziri village. How it came to happen I do not know. They call themselves Bayas, and they are the subjects of the chief Baya, and in every sense politically and socially they are Bayas; but by origin I should think from the type of building they must be Banziris, unless Baya's father, seeing the Banziri hut, resolved to copy their style of architecture, and made this attempt. The difficulty of getting information about anything in the past is very great, because ordinarily the healthy man lives to only 37 or 38 years of age at the most. A man anything over 40 is an old man. The consequence is that by the time a man has grown old enough to remember anything he is dead before he can hand it on as intelligent history, in our meaning of the word. I could not get particulars of anything that happened in the days of Baya's father's boyhood, or whether it was he who introduced the new style or his grandfather. The natives had many stories as to why these huts existed, but there was no reliable information to be obtained, and no two natives told the same story.

The next photograph is a general view of a group of huts showing the extraordinary variety of architecture. It is not a brick house, but another type of mud house. It consists almost entirely of a large verandah, and at the end there is a kind of office where the over-chief of the village, or ward, does his business.

In the next slide another characteristic of the Baya buildings is shown, namely, the beginning of the minarets or curious caps which they put on the top of their conical huts.

Amongst the Gembele, another division of the Banza, these things develop into the most elaborate ornaments, some of them ten or twelve feet in height, enormous structures resembling the pagodas that you see in China. They have a sort of umbrella shape, with antlers hanging from the corners, giving quite a pagoda-like look to the house. The town of Baya having apparently copied the architecture of all the neighbours round about, has copied the pagoda effect in some of the huts.

The next photograph to many of you will be the most interesting view I have shown, because it depicts the degree to which the social organisation of the place has been developed. We have heard a great deal recently about the underfed school children of England, and here is the Baya solution of the difficulty. All the younger children in each ward or group are kept in a crèche. There is a net work all round enclosing the whole thing, so that the children cannot get into any trouble. For the most part, the children are left there; the mothers go in and out, when they are not too busy. When they are occupied in the fields or with their domestic duties, they simply leave their children in this crèche. Another institution in all these villages that go to make up Baya is the maternity home, a similar establishment to this. These two things from a social development point of view are highly interesting, because they show the

sense of the obligation of the community to look after its individuals. The care taken of their children by the Baya people no doubt in a large measure accounts for the enormous density of population in this part. I did not find these maternity homes and crêches in all the villages of the Baya tribe, but in every one of the villages making up the town of Baya as a whole there existed a separate maternity home and a separate crêche for each village.

These photographs show the ornamentation of the huts and the pagoda-like appearance. You will notice three ornaments hanging from the hut, and a pair of antlers on the top. That is the farthest point to which this pagoda arrangement has reached in the town of Baya. The next view shows a general group of huts, indicating more plainly the fringe-work ornamentation of the roofs in many of the shelters. You see here how beautifully the whole town of Baya is kept up, and how clean it is. It is approached by a road that took a good hour to traverse, which is kept as well as any avenue in any of the white stations that I saw.

The next photograph gives you an idea of their stock farming, and shows you their pigeon houses. I could never make out what the object was of setting them up to such an enormous height. In all this part of Africa they keep large numbers of pigeons and fowls in every village, and there are often large flocks of goats. The fowls, but more particularly the pigeons, are kept in extraordinarily elevated abodes. You often see the fowls flying up from roof to roof in order to reach the fowl cot, which stands about ten or twelve feet from the ground. The pigeon houses, of which there are dozens, must be 25 or 30 feet high. I could not find out why they were raised to this extreme height, but it was a common custom of the people in this part to build their dove cots and fowl houses to a considerable height.

The next view shows the houses grouped together, with an evident eye to effect. Whoever did it intended that the town should present a varied and picturesque effect, and succeeded most admirably.

The next photograph shows Baya on a visit to the white man. Perhaps you would like to know the history of my meeting with him. I was laid up very ill in a village, and he came across me and conducted me to the white station. Then I went out and paid him a visit at his capital, about two days' march, and he came back and returned the visit to me in the white station.

He came with an enormous number of his people. Whenever these tribes come in there are always quantities of disputes to be settled, varying from the minutest and most delicate domestic quarrels up to the most complex and elaborate points in intertribal law. You will see that Baya is dressed in a white European suit and cap; he always wears white boots, and dresses in thoroughly European fashion. The photograph shows the Resident delivering judgment on some case. It shows the very high intelligence and adaptability of the Banza, who were the absolute enemies of the white man only seven or eight years ago, and blocked his progress completely in a large part of Central Africa, when you find that nearly every tribe is now on the terms of the utmost friendship with the white man.

The next photograph shows you my tent in the bush, and gives you an idea of the way in which one travels. One travels across a country like Africa, either with a caravan of bearers, who carry everything you possess; or, if you travel by water, you travel in large canoes, of which you require quite a fleet. You can imagine the joy of sitting for thirteen hours in the broiling sun in one of these canoes, with perhaps twenty or thirty natives shouting, dancing, jumping, halloaing as they paddle; there are at least two or three tom-toms in the canoe and several brass jangles and two or three ivory horns all keeping time with the paddlers. This goes on for thirteen hours, during which one is bound to keep almost in the one position, because they do not stop. The native likes to get to his journey's end as quickly as he can, and if you stop him he grumbles and says you are not treating him properly. The only way to keep the natives in good spirits is to allow them to make as much noise as they like, and let them go on paddling from half an hour before sunrise to half an hour after sunset without a break. I am perfectly certain that no white man, however strong, could possibly do the amount of work which these people get through in the course of a day with the willingness and the general air of enthusiasm that these fellows show.

I very much regretted when the time came for me to leave the Ubangi and all these charming people, because one gets a very real affection for them, especially in my case, because during a very severe

illness I was entirely dependent on them. I was very dangerously ill, and whenever I came to myself I saw the black face of a petty village chief, who had taken me out to hunt on the occasion on which I was bowled over by the heat. He very much regretted it, and looked upon it largely as his fault. He stuck to me right through to the end of my trip, and was a most passionately devoted creature. At first I could not speak a word of his language, and he could not speak a word of mine, but whenever I came to he was there. He was never in the way, and if I wanted anything he seemed to divine it. If I wanted to punish that man if he did not behave himself, I had only to put him in another canoe for a couple of hours, and he was then exactly like some dog that one has reproved, which seems to understand the reproval, and be pathetic for the rest of the day, I took poor old Njabili down with me to see the coast towns on my return. He was astounded when he saw even the primitive white towns that existed, such as Boma, which is nothing like a European town. His final remark to me when I said goodbye to him was that he was going back to be one of the greatest chiefs that had ever lived, because he had got enough money to buy five new wives.

DISCUSSION.

The CHAIRMAN, in proposing a vote of thanks to the author for his charming and interesting paper, said that his Lordship's remarks on cannibalism had reminded him of the very early days in New Zealand when cannibalism was supposed to be rife. He questioned very much indeed whether any nation had ever really gone in for cannibalism purely for the love of it. That certainly was not so in New Zealand. The natives had in the far distant past occasionally eaten their captives and the white man, whom they designated as the long pig; but they did not approve of the flesh of the white man at all. Their idea of the cannibalism which they occasionally indulged in was that by eating the flesh of the victim they would inherit his virtues; if they managed to partake of the flesh of a great chief they would inherit some of his spirit, and be imbued with some of his virtues. The tattooing in New Zealand was of a much more complicated and elaborated form than that shown in the author's views; in fact, native tattooing, not very long ago, and even to this day, was a work of art, and in some cases a very beautiful picture. He had been particularly interested with the author's description of the country he had passed through, especially his remarks about Baya and its population, and its crèches and maternity homes, because from the little he had seen of both East and West Africa the great trouble of those countries was the lack of population, and the one thing that kept British settlements in Africa back was that want of population. The country was intensely fertile and wealthy, and if there was only a large population he was sure an enormous trade would be done with this country. He had seen something of the intelligence of the natives and their skill in manufactures as described by the author. In British West Africa he had seen the natives make mud huts, which were called cob huts in Australia and New Zealand, adobe in America, and switch in America. He had seen the natives build such houses in perfectly straight lines, and at right angles, and square up the whole thing just as English workmen would do with a variety of tools. He had seen a lady take a piece of mud or clay, roll it up in her hands, and gradually mould it in an incredibly short space of time into a handsome vase 36 inches high. Without the use of a pottter's wheel the people could work up vases in beautifully symmetrical form and design. He had also seen something of the iron-work of the people. Mr. Bellamy, the Director of Public Works in the colony of Lagos, read a most interesting paper not long ago on the smelting of iron ore in the interior of Lagos, some 200 miles from the coast, where the natives from unknown antiquity had carried out the process of smelting iron. The whole process was described of getting the ore out of the ground, smelting it, puddling it, taking it to the blacksmith's shop, and forging it into agricultural weapons and tools of a more or less primitive nature. He admitted that in regard to native questions he was a little prejudiced, because the only knowledge of the native he possessed had been gained amongst the finest type of natives in the world—New Zealand. He had been intensely struck, however, not only with the intelligence of the natives of East and West Africa, but with their kindliness, good will and attention towards each other, and the general spirit of friendliness which they displayed. In recently looking up the travels of one of the most celebrated travellers, whom he was afraid was too much forgotten in these days of civilisation—Mungo Park—he particularly noticed how that great explorer travelled with almost nothing except the clothes he stood up in and a few strings of beads and brass rods. In the days to come the whole of Africa presented a problem which would be of the greatest importance to the British Empire and to the rest of the civilised world. Somehow or other, Germany, France, the King of the Belgians, and England had virtually annexed the whole of Africa. Portugal had already a large share. He hoped and trusted that English rule in Africa would be for the good of the natives themselves, that we should never forget that the country was their country, that they were the only people who had a right to it, and that our only duty in Africa, either

as Christians or as members of a civilised community, was to do everything possible to promote its prosperity, not to be in too great a hurry and impatient of their ways, but to feel that in introducing European manners and customs amongst them we were endeavouring to spread, not only the true light and doctrines of Christianity, but the great blessings of civilisation; and that we were not there, and would disapprove others being there, simply for the purpose of greed or gain.

The vote of thanks having been carried unanimously, the meeting terminated.

CHICAGO.

In his exhaustive and interesting report upon the trade, commerce, and agriculture of the consular district of Chicago for the year 1904, Mr. Consul Finn (No. 3,349, Annual Series) does much to dispel current misconceptions of Chicago, and to indicate the means by which British manufacturers may retain and increase their trade with it. Chicago has a population of over 2,000,000 inhabitants, of whom some 400,000 are Germans and 300,000 British subjects, or British Americans, that is to say British subjects who have taken out United States naturalisation papers. The growth of the city may be gathered from the fact that the frontage erected in the last four years exceeds 146 miles, costing £30,000,000. Thirty-two railroads run 1,839 trains into the city daily; over 16,000,000 live animals came into the city last year; the grain elevators have a combined capacity of 60,000,000 bushels; the telephone system has 113,000 subscribers, and Chicago is only surpassed in manufacturing by London. It is also a port where in 1904 there were entered and cleared 12,904 vessels, with an aggregate tonnage of 12,746,078 tons. Chicago is increasing rapidly as a factor in financial matters, for it has £121,000,000 deposited in its banks, and is becoming the centre and clearing-house of all the Western country.

Much is said in the newspapers which suggests that Chicago is a wild Western town, and Mr. Finn admits that crime with violence is rampant, principally because of the insufficiency of the police and the absence of check on the carrying of arms. But the other side of the picture is a very striking one. There are few cities where so little drunkenness is seen, and none where the people are more able to provide the necessaries of life without appeal to charity. In 1904, Cook County, in which Chicago lies, with a population of over 2,500,000, had 22,301 inmates in the county hospital, and out of this number only 228 were on the list as suffering from excessive use of intoxicants, while during the same time only 3,049 persons were admitted to the poorhouse, the average number of inmates being 1,160. In relieving people in their houses i Chicago great care is taken not to pauperise them, only 7,650 cases being relieved during the past year from one to twelve times at a cost per family of £2 5s. 10d. a year, that is 10s. 11¾d. per head relieved. The streets of Chicago are dirty, but the city has the best water supply in the world, large parks, and many small breathing spaces, whilst its debt is only £4,000,000, or under £2 per head of the population. It has two universities, which are rapidly proving themselves to be leaders in research and study; it has taken a very decided lead in its treatment and care of juvenile delinquents and other children who come under the care of the State, and every social problem which comes before the public is considered very thoroughly.

The extraordinary prosperity of Chicago is largely due to its marvellous supply, still only very partially developed, of mineral and agricultural wealth, to the low first cost in most parts of the country of its multitudinous railroads, which quote low rates for the producer and thus encourage men to start business, and to the enthusiasm put into all work by the reward of promotion and better pay to the best men in all walks of life. Specialising is now to be found only in the rank and file. The men who wish to rise must have a good general knowledge and must keep up with the times to do their work satisfactorily. In most business houses a very careful record is kept of each man's work, and in many a system of profit-sharing has been instituted, because it has been found that the employers' and *employés'* interests must be identical to obtain success.

Mr. Flinn says that there is a market in Chicago in competition with the domestic and foreign manufacturers for all or any articles of British manufacture with the exception of such things as are made from raw products supplied by the United States. During the last eighteen months inquiries have been made at the Consulate for the names of British firms wishing to export the following:—Bristles and fibres for brushmakers, burlaps, perfumery, toilet articles, drugs, china, crockery and earthenware, chocolate, rulers, ship's wagons, paper of most kinds, cocoanut oil, felt roofing and building paper, pepper, nutmegs, glass ware, electrical and gas glass-ware, electrical sockets and specialties, imitation antique jewellery and plate, shellac, wax and varnish gums, wooden and wax matches and fusees. There is said to be a demand for all these things, and trade in them possible if brought before the public in the manner they are accustomed to. Mr. Finn points out the great number of former British residents scattered through all parts of the country, and thinks that there is no doubt but that British food articles, such as biscuits, pickles, jams, and sauces would find a sale among a people who have been accustomed to and know them, and are now in a position to purchase them. Unfortunately Mr. Finn has to make the usual complaint as to British indifference. The Consulate has, he says, on many occasions asked for names of persons in the United Kingdom wishing to export many different kinds of articles but seldom received a reply.

Much he thinks might be done especially if the British merchant could see his way to adopting some American methods as regards his trade with the United States. One of these is by appointing a resident in business in Chicago as agent on commission, and another by employing some one as sole representative. Business men will find much to interest them in Mr. Finn's advice on these points.

Mr. Finn has some remarks on advertising to which the attention of British manufacturers may be usefully directed. The American, he says, believes in advertising and does it to the utmost. It is impossible for the British manufacturer to hold his own, to say nothing of increasing his trade in America unless he adopts the same system as his rivals. There are many British goods which if advertised in the same manner as the competing American product, would, because of their superiority, soon obtain a hold on the market and give good returns to the advertisers. This trade can be got as is shown by a well-known and well-advertised soap, that has an enormous sale and holds its place notwithstanding the fact that its price is about three times that of its competitors. In America and Canada the methods of obtaining business are alike, and these methods must be used by the British manufacturer, but in so doing there are so many mediums, conditions, and even idiosincrasies of localities to be considered that each case and the best manner of advertising must be considered on its own merits. America is a large continent, and to advertise widely is very expensive when compared with advertising in the United Kingdom, but one district can be taken hold of and then others added as business comes in. British manufacturers will also find that their wares must be brought before the American public through the different papers and magazines read by the buyers, and that advertisements in British trade papers have little or no effect in America, as they are only consulted when something definite is wanted, and for which no substitute is to be found in the pages usually consulted.

Mr. Finn has some interesting remarks upon American trade with Canada. In 1904 the sales to Canada from the United States were 60 per cent. of the total purchases of the former country, while those from the United Kingdom were 24·5 per cent. The trade from the United States has increased by more than 5,000,000 dols. in the last two years, and American manufacturers have, under the present system of doing business, no fear of British competition, notwithstanding the preferential tariff. Should, however, any British manufacturer employ an agent in Chicago, he might make arrangements for him to look after the Canadian trade, and canvass Ontario and the North-West Territories from Chicago, as they can be reached in 24 hours, and the pushing methods and advertising of the Americans are understood there. The American manufacturer is eager, Mr. Finn says, for the Canadian trade, and will, if any change is made to increase the Canadian tariff, open branches in that country for the manufacture of his goods, as has already been done in several cases. Mr. Finn has been told, and apparently accepts the statement, that in the manufacture of most articles a tariff of 10 per cent. makes no difference in the price charged the consumer, and must be saved in the cost of manufacture and distribution, but that when over 25 per cent. is demanded, the price must be raised or the article manufactured in the country. The British manufacturer must not expect anywhere in the near future any sweeping change in the American tariff. The United States is so large, the interests and climate so diverse, that changing the tariff will be a difficult matter, as each section of the country seems to be ready to accept a reduction in those articles which it consumes, but not in those which it produces. "If," says Mr. Finn, "our merchants want a share in this trade, they must conform to the requirements of the country, and if they do so the superiority of their wares will ensure them of a good trade for a considerable time; but the American is turning out better work every day, and will soon come to compete in the better-class trade as the demand for it increases."

BRITISH WHEAT SUPPLY.

In the *Journal* of December 2, 1904 (page 53) statistics were quoted to show not only the great and growing dependence of the United Kingdom upon foreign countries for its wheat supply, but the shifting character of that supply. In 1872 Russia sent us more wheat than any other country, and twice as much as the United States. Neither the United States nor Argentina sent us any. In 1890 the position had been entirely changed. Whilst we got 13,561,000 quarters from the United States, and 4,322,300 quarters from Argentina, Russia sent us only 1,031,700 quarters. Coming down to last year, there was another great shifting of supply. The British East Indies, which in earlier years had not sent us any considerable supply, headed the list with no less than 20,469,100 cwts., Argentina coming next with 18,466,700 cwts., Russia third with 16,827,100 cwts. Australasia, recovering from her long-continued drought, sent us 9,268,400 cwts., and the United States had fallen to the fifth place with 6,541,100 cwts. "It would not be safe," it was said, "to base definite conclusions on the figures of the ten months of the present year (1904), but it may be taken as certain that in future we must look to other countries than the United States for our chief wheat supplies."

The accounts relating to the trade and navigation of the United Kingdom, just issued, show that the trend remains unchanged. The largest imports of wheat continue to come from the five countries named above in the order there given. Taking the month ended April 30th, 1905, and the four months, January-April, 1905, the imports were as follows:—

	Month ended 30th April.	Four months ended 30th April.
	cwts.	cwts.
British East Indies	1,442,700	9,493,100
Argentina........	3,697,400	7,786,700
Russia	1,447,700	7,770,700
Australasia	549,500	2,756,000
United States	554,000	2,037,100

Perhaps the most remarkable fact as shown by these figures is the extent of the Russian exports of wheat. Notwithstanding the continuance of the war she maintains her position as third on the list, and her exports of wheat to this country are practically the same as those of Argentina, whilst last year they were considerably less.

Hardly less remarkable is the diminution of imports from Canada. In the paper to which reference is made above, Messrs. Montagu and Hubert were quoted as saying in "Canada and the Empire," that the Dominion may be in a position within comparatively few years, after supplying all home demands, to furnish Great Britain with all the wheat and flour she requires, and leave a surplus for export to other countries. And, undoubtedly, if even a fourth of the land said to be cultivated in Manitoba and the three provincial territories were under crop with wheat annually, Canada would be able to meet the requirements of the Mother Country several times over. But at present her exports to the Mother Country not only do not increase rapidly, they are falling off; if, that is, the first four months, or the month of April, in the last three years be taken for comparison. The figures are below :—

Month ended 30th April — 1903, 486,779 cwt.; 1904, 242,100 cwt.; 1905, 114,400 cwt. Four months ended 30th April — 1903, 1,857,171 cwt.; 1904, 1,827,200 cwt.; 1905, 773,600 cwt.

In 1904 the decrease, taking the four months, was very light as compared with 1903, but comparing the four months of 1905 with those of 1904 it is nearly 60 per cent.

GENERAL NOTES.

Irrigation in the United Provinces.—In the *Journal* of May 5th, an account was given of a large irrigation scheme for the Punjab, sanctioned by the Indian Government. On April 18th last, it was announced at Simla that the Secretary of State had sanctioned an estimate, amounting to Rs.40,390,000, including indirect charges, for a project for constructing a canal from the Dassan River in the Hamirpur district of the United Provinces. The canal will be 20½ miles long, with two branches, namely, the Jalalpur branch, 28½ miles, and the Mandha branch, 14½ miles, and a system of tributaries whose total length is estimated at 210 miles. It will command some 326,000 acres, and will protect a large tract of country from drought. The project should irrigate 57,000 acres in an ordinary year, and about 73,000 in time of drought. The net revenue anticipated is just over one lakh, equivalent to 2·6 per cent. on the outlay.

Post Office Savings Bank Fund.—A return (108) giving the amount of Consols (including Reduced and New 3 per Cent. Stocks) bought and sold for cash, and the cash paid and received for the same, for each year since the establishment of the Fund, has just been issued. The amount of Consols bought for cash since the Fund was created in 1861 is £147,521,398, and they cost £148,507,530. The amount sold for cash was £18,866,189, so that the excess bought is £128,655,209. The highest price given was in 1897 when £6,349,485 was bought at the price of 112·30, in 1898 £4,370,309 was bought at 111·23, and in 1896 no less than £11,543,121 at 110·27. Only £690,624 was bought in 1903 at 91·57, and £50,000 in 1904 at 87·97. The highest price got when selling was in 1887 when £41,947 was sold at 102·5, the lowest in 1904 when £90,000 was sold at 88·38. Taking the whole of the purchases the average price was 100·67, and taking the whole of the sales the average price was 95·86.

German Interests in Venezuela.—German papers claim that about one million sterling of German capital is invested in real estate in Venezuela, and that the bulk of the foreign trade of the Republic is transacted by Germans, of whom about 2,000 reside in the country. Forty large German firms are engaged in trade there. In Caracas they have their own schools, clubs, and societies, and a newspaper published in German. The further claim is made that the Germans have built the railways, and that the manufacturing establishments in the Republic have been organised and are carried on by Germans.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings, at 8 o'clock :—

May 17.—"The Use of Wood Pulp for Paper Making." By S. Charles Phillips, M.S.C.I. Lord Strathcona and Mount Royal, G.C.M.G., will preside.

May 24.—"Modern Lightning Conductors." By Killingworth Hedges, M.Inst.C.E., Hon. Sec. to the Lightning Research Committee. J. Gavey, C.B., Engineer-in-Chief to the Post Office, will preside.

Indian Section.

Thursday, at 4.30 o'clock :—

May 18.—"Plague in India." By Charles Creighton, M.D. Sir Dennis Fitzpatrick, K.C.S.I., will preside.

Colonial Section.

Tuesday, at 4.30 o'clock :—

May 23.—"The Cape to Cairo Railway." By Sir Charles H. T. Metcalfe, Bart., M.Inst.C.E. The Duke of Marlborough, K.G., will preside.

Applied Art Section.

Tuesday, at 8 o'clock :—

May 16, 8 p.m.—"Excavation of the Oldest Temple at Thebes." By H. R. H. Hall, M.A. Reginald Hughes, D.C.L., will preside.

Cantor Lectures.

Monday evenings, at 8 o'clock :—

Henry Willock Ravenshaw, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

Lecture I.—May 15.—*Application of Electricity and Character of Load.* — Winding—Haulage—Pumping—Coal cutting—Other uses underground—Surface requirements—Generating stations—Cables and distribution — Lighting — Signals — Telephones—Shot firing.

Lecture II.—May 22.—Alternating and direct currents — Precautions — Enclosed motors — Home Office rules—Costs—Typical and historical plants described.

The lectures will be illustrated by lantern slides.

MEETINGS FOR THE ENSUING WEEK.

Monday, May 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. H. W. Ravenshaw, "The Uses of Electricity in Mines." (Lecture I.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. D. Wallis, "The Licensing Act, 1904: with Special Reference to the Question of Compensation and Monopoly Value."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Capt. C. H. Ryder, "A Survey Expedition to the Sources of the Brahmaputra and the Sutlej."

British Architects, 9, Conduit-street, W., 8 p.m. Papers on "Sculpture and Architecture."

Camera Club, Charing-cross-road, W.C, 8½ p.m. Mr. J. H. Knight, "Motor Cars."

Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. H. G. Griswold, "The Messiah of Quadian."

Tuesday, May 16...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. H. R. Hall, "Excavation of the Oldes Temple at Thebes."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. L. C. Miall, "The Study of Extinct Animals." (Lecture III.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Leonard Waru, "The Effect, as shown by Statistics, of British Statutory Regulations Directed to the Improvement of the Hygienic Conditions of Industrial Occupations." (Howard Medal Prize Essay.)

Pathological, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. F. J. Mortimer, "Marine Photography."

Zoological, 3, Hanover-square, W., 8½ p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Col. H. De la P. Gough, "The Stragetical Employment of Cavalry."

Wednesday, May 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Charles Phillips, "The use of Wood Pulp for Paper Making."

Meteorological, 70, Victoria street, S.W., 4½ p.m. 1. Mr. Richard Strachan, "Measurement of Evaporation." 2. Dr. John Ball, "Logarithmic Slide-Rule for Reducing Readings of the Barometer to Sea-level."

Chemical, Burlington-house, W., 5½ p.m. 1. Mr. W. J. Sell, "The chlorination of methyl derivatives of pyridine. Part I.; 2—methyl pyridine." 2. Prof. W. N. Hartley, "The absorption spectra of uric acid, murexide and the ureides in relation to colour and to their chemical structure." 3. Mr. H. J. H. Fenton, "Further studies on dihydroxymaleic acid." 4. Messrs. W. A. Bone and H. L. Smith, "The thermal decomposition of formaldehyde and acetaldehyde." 5. Messrs. D. L. Chapman and A. Holt, Jun., "The synthesis of formaldehyde." 6. Messrs. K. J. P. Orton, J. E. Coates, and (in part) F. Burdett, "The influence of light on diazo reactions." (Preliminary notice.)

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. D. D. Jackson, "The Movements of Diatoms and other Microscopic Plants." 2. Exhibition of Slides of the Oribatidæ.

Botanic, Inner Circle, Regent's-park, N.W., 2 p.m. Exhibition of Plants and Flowers.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. Annual Meeting.

Thursday, May 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Dr. Charles Creighton, "Plague in India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Faraday Society (in the Library of the Institution of Electrical Engineers), 92, Victoria-street, S.W., 8 p.m. Dr. T. M. Lowry, "An Application to Electrolytes of the Hydrate Theory of Solutions."

Royal Institution, Albemarle-street, W., 5 p.m. Prof. Sir James Dewar, "Flame." (Lecture III.)

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m. Dr. W. H Workman, "Further Explorations in the Himalayas."

Friday, May 19...Royal Institution, Albemarle-street, W. 9 p.m. Sir Charles Elliot, "The Native Races of the British East Africa Protectorate."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7 p.m.

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Paper on "Illuminated MSS."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Saturday, May 20...Royal Institution, Albemarle-street, W., 3 p.m. Dr. J. G. Frazer, "The Evolution of the Kingship in Early Society." (Lecture I.)

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FRIDAY, MAY 19, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MAY 22, 8 p.m. (Cantor Lecture.) H. W. RAVENSHAW, Assoc. M. Inst. C.E., "The Uses of Electricity in Mines." (Lecture II.)

TUESDAY, MAY 23, 4.30 p.m. (Colonial Section.) SIR CHARLES H. T. METCALFE, Bart, M.Inst.C.E., "The Cape to Cairo Railway."

WEDNESDAY, MAY 24, 8 p.m. (Ordinary Meeting.) KILLINGWORTH HEDGES, M.Inst.C.E., "Modern Lightning Conductors."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 15th inst., Mr. H. W. RAVENSHAW delivered the first lecture of his Course on "The Uses of Electricity in Mines."

The lectures will be published in the *Journal* during the autumn recess.

APPLIED ART SECTION.

Tuesday evening, May 16; REGINALD HUGHES, D.C.L., in the chair.

The paper read was on the "Excavation of the Oldest Temple at Thebes," by H. R. HALL, M.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

INDIAN SECTION.

Thursday afternoon, May 18; SIR DENNIS FITZPATRICK, K.C.S.I., in the chair.

The paper read was on "Plague in India," by CHARLES CREIGHTON, M.D.

The paper and report of the discussion will be published in a future number of the *Journal.*

BUST OF THE LATE SIR EDWIN CHADWICK.

The Council have received a terra cotta bust, by George Tinworth, of Sir Edwin Chadwick, K.C.B., the eminent Sanitarian, who was a prominent member of the Society of Arts from 1847 until his death in 1890, and for many years a member of Council, and Vice-President. The bust has been presented to the Society by Sir Edwin's daughter, Miss Marion Chadwick.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 4, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 17, 1905; LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., High Commissioner for the Dominion of Canada, in the chair.

The following candidates were proposed for election as members of the Society:—

Bell, Sir Hugh, Bart., Rounton-grange, Northallerton, and 95, Sloane-street, S.W.

Faulkner, Alfred Robert, Fairholme, Worple-road, Wimbledon.

Knowles, Mrs. Marian, 24, St. Edmund's-terrace, Regent's-park, N.W.

O'Shaughnessy, Hugh Patrick, Executive Engineer, South Indian Railway, Trichinopoly, India.

Tate, James C., St. Malo, Seaford.

Vernon, William Henry, The Laurels, Livingstone-road, Birchfield, Birmingham.

The following candidates were ballotted for and duly elected members of the Society:—

Cato, W. C., Malvern, Augusta-road, Hobart, Tasmania.
Davis, Charles E., 847, North Church-street, Rockford, Illinois, U.S.A.
Parker, Critchley, Broken Hill-chambers, 31, Queen-street, Melbourne, Australia.
Ruffer, Henry, Menival, Crystal Palace Park-road, S.E.
Sheath, James T. T., 87, City-road, E.C.
Sturgess, Archibald T., M.I.Mech.E., Messrs. Sturgess and Foley, Alcala 52, Madrid, Spain.
Thompson, Charles Herbert, F.C.S., Enville-street, Stourbridge.

The paper read was—

THE USE OF WOOD PULP FOR PAPER-MAKING.

By S. Chas. Phillips, M.S.C.I.

It was with peculiar pleasure that I accepted the compliment you were good enough to pay me, when you invited me to read a paper on the subject of "Wood Pulp." I have been reminded of the fact that there are in this Society many members who have no practical acquaintance with paper-making or with the subject I am trying to deal with to-night, and therefore, I hope to avoid technicalities as much as possible, although I think you will readily see it is necessary in a paper of this kind to deal in a general way with the evolution of the wood pulp industry, and particularly in its application to paper-making, and in this connection, to deal historically with the progress of pulp-making and its chemical treatment. I think, perhaps, I need scarcely say at the outset, that in the cheaper forms of paper, as we know it to-day, the raw material is substantially wood. I am aware that if you were to ask "the man in the street" of what paper is made, you would probably be told "rags;" but although that used to be the case, the use of paper to-day is so extensive that it would be impossible to meet the demand for one-thousandth part of the total consumption, if the paper-maker had to rely on rags, and I think I may here say that it is due to the engineer and to the chemist that we owe our cheap Press, and largely to the fact that wood has been taken full advantage of in its application to paper-making. For reasons which I may refer to later on, it is obvious that although England holds its own very comfortably at present as a paper-making country, it is not at all probable that Great Britain will ever produce wood for paper-making on a commercial scale. Not long ago, one of our leading paper-makers, whilst referring to this subject, observed that we might hope to make wood pulp here when we had the water-falls and timber forests of Canada, Norway, or Sweden. There was a great deal of truth in that remark, and although there are gentlemen who are sanguine that we might make very much more use of our forests and unproductive land than we do, that we might turn it to good account for timber growing, I do not think that for practical purposes we need, at the present moment, take that into consideration. We may (and I am speaking from practical knowledge) dismiss Great Britain out of the calculation when we are dealing with the great countries which are providing us with timber for the production of wood pulp, and are likely to do so for very many years to come. It may, I think, be said, roughly, that the wood-pulp industry has established itself and attained its present position during the past quarter of a century, There was a time within my own recollection when the manufacturers of high grade papers in this country looked askance at wood, and I know of a gentleman in the wood-pulp business who told me that about twenty years ago when he waited upon a well-known Maidstone firm, and tried to induce them to give a trial to good chemical wood pulp, the owner of the mill was very rude to him, and almost ordered him away from the place. But times have changed since then, and at the present moment many of the mills which in the early days of wood pulp derided its possibilities would not hesitate to place a very large order for the same, at what they might consider a reasonable price. To those who are uninitiated in what I may term the elementary details of the wood-pulp industry, it may be necessary to mention that for the purposes of a paper of this kind, we must bear in mind that there are, to put the matter broadly, two methods of transforming raw wood into pulp.

Mechanical and Chemical.

I have, I may say, travelled a great deal in the principal pulp-producing countries, particularly Sweden, Norway, Finland, the United States, and Canada, visiting the most up-to-date mills where all classes of wood pulp are made, and so have had excellent opportunities

for studying and comparing the various processes now in use. Sweden and Norway are countries from which we have for years derived our principal supply of wood fibre for paper-making. Years of practical experience have taught the Scandinavians to produce the best wood pulp in both mechanical and chemical varieties; but although both Sweden and Norway claim to have enormous forests of pulp wood, yet in spite of the law in Sweden which compels the replanting of six saplings for every tree cut down, it seems to me that at the rate at which the forests are being denuded of their timber for other purposes besides the conversion into wood pulp, in less than twenty-five years from now the maintenance of the timber supply will become a grave question. While in South Germany timber fit for pulping can be grown in fourteen or fifteen years, in Scandinavia it takes about forty years.

During the past dozen years our great Dependency in the Western Hemisphere, viz., the Dominion of Canada — of which our distinguished Chairman, Lord Strathcona and Mount Royal, is the representative in this country—has come forward as a pulp-producing country, much to the relief and satisfaction of British paper-makers; for, with the growth of Canadian competition, it has become an important factor in keeping the prices of pulp from Sweden and Norway from being advanced higher than was justified in normal times. So that the advent of Canada into the wood-pulp business is likely to have a steadying influence in the matter of prices. I am pleased to say that Canada is making great progress in the industry by the construction of new mills, and the extension and improvement of existing mills. Our Chairman (Lord Strathcona) takes a keen interest in the wood-pulp industry of Canada, and has been largely instrumental in its development. As a frequent visitor to Canada, I trust that the Canadian Government will not be long before it adopts the replanting system of Sweden and Germany. At present there is but little attempt to protect the colossal and magnificent forests of the great Dominion of Canada, which are the envy of the whole world. What with the enormous wastage that goes on, and the serious inroads made by forest fires and indiscriminate cutting, Canada will have to take speedy steps to take care of the magnificent and great wealth which Nature has endowed her with in her forests, or otherwise she will, long before the present century closes, be bereft of that grand birthright.

In an essay published by Réaumur in the eighteenth century there is a suggestion that it might be possible to make paper from wood, and in 1750 paper was made from the bark, leaves, and wood of various trees in France. The class of wood generally used for the manufacture of chemical pulp is known as soft wood, and belongs to the order Coniferæ, or cone-bearing trees. The common spruce and the silver fir are the chief species that supply the chemical pulp of Europe, while the white spruce, black spruce, Canadian Hemlock, white American pine, and the silver fir furnish the bulk of wood pulp in America. For mechanical wood pulp, poplar, aspen, spruce, and fir are mostly used. Although almost every class of wood can be converted into pulp, only the soft coniferous trees are economically suitable. Trees having a diameter of from 6 inches to 20 inches at the base, and of about twenty years' growth are considered best. Smaller logs are not so economically worked, and larger timber is usually cut for lumber. Within the last few years a great number of pulp mills have been started in the southern and western States of America, and other parts of the world, which, in order to utilise the particular class of wood growing in those districts have adopted somewhat special methods, and we now find wood pulp being produced from a great variety of woods. The great majority of pulp mills obtain their supply of wood in the form of round logs about 6 to 10 feet long, while many in the lumber cutting districts use edgings and other waste wood from sawmills.

Sawdust has also been experimented with for the purpose of producing chemical fibre, but owing to the difficulties of getting the solvent liquor to circulate readily through it, and other troublesome features, it has been found to be impracticable. Shavings would be more suitable for converting into wood fibre, and are employed by some, although their bulkiness prevents any substantial weight being dealt with in each boiling operation. They might, however, be more conveniently used if they were first put through some form of machine similar to a hay-cutting mill, and reduced to small lengths.

Like ordinary lumber, the logs employed for pulp-making are generally cut by gangs of woodmen, who camp out in the forest during the winter months. In the early spring, when the snow and ice begin to melt, the logs are easily conveyed to the banks of the river, which, being at this time naturally swollen,

carries them down to their destination. The log-driving men's duty is to keep them off the banks, and clear of obstacles, until they reach the saw or pulp mill, where booms, consisting of a number of logs chained together endwise, are stretched across the river to prevent them from being drifted any further. By this means millions of feet of logs are annually brought from the centre of the forests down to the mills. The result of being in the snow and water, and the friction in driving, is such that the logs generally arrive at the mill with the bark entirely removed.

In Europe, Scandinavia, Russia, Austria, and Germany possess the largest wood pulp forests, which, in the former countries, are the natural virgin growth, and still very extensive, in spite of the enormous quantity annually cut. In Germany the original natural forests have been almost exhausted, but owing to the wisdom and foresight of the authorities, they have been replanted and grown under Government supervision. Undoubtedly the American continent has the largest supply of pulp wood, but even the extensive forests of the Adirondacks and similar districts round the large paper-making centres are rapidly becoming depleted by the pulp manufacturers. The State of Maine and other New England States have still enormous quantities of uncut pulp wood, but unless measures are taken to preserve and cultivate them, the present rate of cutting cannot be indefinitely continued. The immense virgin forests of pulp wood in Canada and Newfoundland are practically untouched at present, but the day is not far distant when great demands will be made upon these forests.

Pulp wood is generally bought by measurement; the fact that the amount of water contained in the wood varies so considerably prevents any method of dealing with it by weight. The method of measuring timber is also very troublesome and unsatisfactory, more especially by the tape or quarter-girt system. Measuring in fathom frames is costly work, and, like pile measurement, varies according to the skill or otherwise of those piling the logs. In America, wood is generally bought by the cord, which equals 128 cubic feet pile measurement. In Great Britain and Scandinavia it is usually bought by the fathom, which is a cubic pile of logs 6 feet long, and piled 6 feet high, containing 216 cubic feet. In many of the Continental countries it is purchased and sold at so much per cubic mètre.

The appellation, wood pulp, includes two distinct varieties having different chemical compositions and properties. These are known in commerce as mechanical or ground wood pulp, and chemical wood fibre or wood cellulose. The former is simply wood ground, washed, and made into layers or sheets; while the latter, or chemical wood pulp, is produced by treating the wood with various chemicals to remove the ligneous and mineral compounds, leaving the soft, pliable cellulose fibres almost pure. Of the chemical pulps, there are also several varieties, named according to the chemical solvent employed in the manufacture—we have sulphite wood fibre, soda fibre, and sulphate fibre, or pulp prepared by the action of sulphate of lime, caustic soda, and a solution of sulphates of soda, respectively.

Wood-Stuff, or Mechanical Wood Pulp.

Dr. Joseph Bersch, a well-known authority, describes mechanical wood pulp as wood converted by purely mechanical means into a fine-fibred mass, which by itself may serve for the production of coarser grades of pasteboards as well as for the manufacture of various articles. Its chief use, however, is as an addition to paper stock for the manufacture of inferior grades of paper. Although wood-stuff, if properly prepared, is sufficiently fine-fibred to be made into paper in the paper machine, it is not used by itself for this purpose, because such paper possesses the undesirable property of becoming darker and acquiring, in a short time, a brown colouration when stored exposed to the light. The cause of this phenomenon is, in Dr. Bersch's opinion, found in the fact that the wood-stuff still contains nearly the entire quantity of encrusting substance—lignin, &c.—originally present in the wood, these substances being subject to great changes. Hence, in the course of time efforts were made to remove these substances from the wood, so that only pure cellulose remains behind, which, as it does not show the already mentioned defects, can be used practically by itself for the manufacture of paper.

Wood for Grinding.

Although practically every kind of wood may be made use of and put into the grinder, some woods are far preferable to others, and of the European varieties of wood, ash, linden, fir, pine, and birch are particularly suited for the

purpose; whilst beech may be used, but is considerably less suitable.

The views on the screen will convey a good idea of the practical operations.

Mechanical Wood Pulp as Made in 1844.

In 1844 there was patented in Germany a machine for grinding wood for the manufacture of pulp. The inventor, Keller, sold the patent to the firm of Henry Voelter's sons, who afterwards used the pulp in the manufacture of "news" paper.

The Voelters made numerous improvements in Keller's invention, and a quarter of a century after it was patented in Germany by Keller this wood pulp machine was destined to play an important part in the United States, when, in response to the demand for the rapid printing of daily newspapers, the web press was to come into use. The Voelters—Christian and Henry—made numerous improvements in the machine, Christian Voelter obtaining patents in various European countries—in France even as early as April 11th, 1847. Henry Voelter patented his improvement on the pulp machine in Würtemburg, Germany, on August 29th, 1856, and in the United States on August 10th, 1858.

Various methods of treating wood previous to submitting it to the action of the grinders have been proposed and used. By one process the logs of wood, after being cut into suitable lengths for grinding are treated by first steaming them, then removing the acids generated in the steaming operation, next treating the steamed wood with alkali, and, finally, grinding or reducing the pieces to pulp. Steaming has been resorted to for the purpose of removing the bark from wooden blocks preparatory to grinding the solid parts; and wood has also been treated with water sprinkled on it from above, and steam simultaneously applied from beneath it, in order to soften and cleanse it preparatory to grinding.

But the process which we shall now describe, which is that of Mr. George F. Cushman, of Barnet, Vermont, is intended to facilitate the disintegration of the fibres, when submitted to the action of the revolving stones by a preliminary cooking of the block of wood in a bath of boiling hot water with lime, soda-ash, or equivalent chemical agent in solution, to soften the block, toughen the fibres, and lessen their lateral adhesion. By this process the block is reduced to pulp with much less power than is required to grind a block not so treated; and the pulp produced is claimed to be softer, stronger, and more desirable, since the fibres are not broken up or comminuted, but are more nearly in their natural condition, with their lateral beards or filaments preserved, so that when re-united in the paper sheet special toughness and tenacity are attained.

In carrying out this method, I believe it is usual to immerse the solid wooden blocks in a strong solution of lime, soda-ash, chloride of lime, or equivalent chemical agent, kept boiling hot by the introduction of steam or otherwise, and adapted to soften the blocks in readiness for grinding, and retain the blocks under treatment from ten to twenty-four hours, or until the liquid has had time to penetrate all parts of the block, and the lateral adhesion of the fibres is so weakened that they will readily separate by the attrition of the grinding-stone without being broken short or reduced to a mere powder; and as the chemical action is most rapid in the direction of the length of the fibres, it is desirable to cut the block much shorter than is usual, or to form tranverse saw-scarfs at intervals between its ends, in order that the solution may readily penetrate from each end to the centre, so as to loosen and toughen the fibres throughout the block. The pressure of steam above the liquiid in the tank tends to force the solution into all the pores of the immersed blocks; then remove the blocks from the tank and subject them to the action of the grinders in the usual way, kseping a constant stream of water upon the stone, and the disintegration will be found to be effected with great rapidity, owing to the preliminary treatment received by the blocks, and also that no washing is required beyond what results from wetting down the stone. The pulp produced is claimed to be of superior quality, and as the blocks have absorbed only so much of the chemicals as is beneficial to the fibre, it is in condition for the successive steps in the production of various grades of paper of special strength, and for numerous other purposes in the arts. If preferred, however, this fibre may be mixed with hard stock made of other material, such mixture producing paper or board of exceptional toughness.

Voelter's Machine for Cutting or Grinding Wood and Reducing it to Pulp.

The art of reducing wood to pulp by subjecting the same to the action of a revolving stone is not a new one, machinery for grinding wood while a current of water was applied to the

stone having been patented in France by Christian Voelter as early as 1847 (*see* "Brevets d'Invention," vol. x., second series), and in England by A. A. Brooman, of London, in 1853 (*see* "Repertory of Patented Inventions," for May, 1854, p. 410).

A large number of inventions for cutting or grinding wood into pulp have been patented; but the enormous development of the paper-making industry, and the cheapening of paper during the last fifteen years are largely due to the general introduction of the machine for disintegrating blocks of wood and assorting the fibres so obtained into classes according to their different degrees of fineness, invented by Mr. Henry Voelter, of Heidenheim, Würtemburg, Germany, and for which invention he received letters patent on August 10th, 1858, from the United States.

In all the processes known or used prior to Voelter's invention the wood had been acted upon by the stone in one or two ways, viz., either by causing lhe surface of the stone to act upon the ends of the fibres, the surface of the stone moving substantially in a plane perpendicular to the fibres of the wood; or, secondly, by acting upon the fibres in such a direction that they were severed diagonally, the surface of the stone moving diagonally across the fibres. The first plan, in fact, made powder of the wood—an obviously unsatisfactory result. The pulp had no practical length, and on trial proved worthless, or nearly so. The second plan was carried out by the use of a stone revolving like an ordinary grindstone, the wood being applied upon the cylindrical surface thereof, the fibres perpendicular, or nearly so, to planes passing through the axis of the stone and the point or locality where the grinding was performed; and this plan also failed, because the fibres were cut off in lines diagonal to their own length, and were consequently too short to make good pulp. There were other difficulties attending the process not necessary here to mention. Such was the state of the art prior to Voelter's invention; and his improvement in the art consists in grinding or milling away in detail from the bundles of fibres which make up a piece of wood by acting upon them by a grinding surface which moves substantially across the fibres and in the same plane with them. In carrying out this improvement upon the art Voelter splits a log of wood and applies the flat side upon the stone, and then the stone so revolves as to cause points upon its surface to pass the fibres in lines perpendicular, or nearly so, to the length of the fibre. By this mode of procedure it is possible to obtain a sufficiently long fibre and save much power. Voelter's improvement in the art consists, further, in re-grinding the fibres by causing them, after being separated from the block, to pass under other blocks of wood, which are being reduced to pulp upon the same stone. The fibres torn out at the first operation are thus rolled over and crushed again and separated into smaller fibre.

Voelter's improvements in the machinery are in an arrangement of pockets with reference to the grinding surface, so as to hold the blocks of wood in such position that their fibres may be separated from the blocks in the manner described, and whereby fibres may be re-ground, and in a contrivance for feeding up the blocks by a positive feed instead of by force derived from weights or springs, as formerly practised; and a contrivance for causing the feed to cease automatically.

On May 22nd, 1866, Mr. Voelter was granted another patent for improvement in his machine for reducing wood to paper pulp, which patent was re-issued on April 23rd, 1872.

Bachet-Machard Process of Disintegrating Wood.

Messrs. Iwan Koechlin and Co. have carried on the Bachet-Machard patent at the Isle Saint Martin, near Chatel (Vosges), France, and it has also been experimented with on a large scale at Bex and at St. Tryphon, Switzerland. At the start the inventors had in view the saccharification of wood, the paper pulp being intended to be only a secondary product of the manufacture of alcohol; but in practice the inverse result has been obtained, the paper pulp becoming the principal product, and alcohol the secondary one.

The wood, previously sawn in thin discs, was thrown into tubs, the filling of which was then completed with water and sulphuric acid, the latter in the proportion of one-tenth. Each tub would contain 188 cubic feet; eighteen hours' boiling was needed; the discs were then washed as well as possible in order to eliminate the acid, then passed through the crushers and the mills. Each 31⅓ cubic feet produced about 330 lbs. of dry pulp; 65 lbs. of acid and 136 lbs. of coal were used for the p oduction of 220 lbs. of pulp. Calculating the value of the wood at 38 cent. per cubic foot, the cost of production of 220 lbs. of pulp would be 8s.

With the Bachet-Machard method a brown

pulp is obtained producing a good brown folding paper costing about 3s. 6d. per 100 lbs. dry pulp. This brown pulp is easily transformed by a half bleaching into a blond pulp costing about 8s. 4d. per 100 lbs., and this can be utilised with or without mixing, for the manufacture of wrapping paper and of all the coloured papers. Up to the present time a method for economically transforming this into white pulp had not been found (1. "Dictionnaire de Chimie," Wurtz, tome ii., p. 749, *et seq.*).

The inventors think that the tenth of acid, which they cause to react at 212 F. upon the wood, saccharifies the ligneous, or rather the incrustating substance without touching the cellulose fibres; thus the cellulose becomes easily separated into fibres by mechanical means. It is probable that the acids modify the incrustating substance and render it friable, and that at the same time certain principles of the wood are converted into glucose.

The process is the same as with straw and esparto, when alkaline washes are used; but it requires more energetic boiling; the proportion of alkali is doubled, and the boiling done at a pressure of 165 lbs.

A little more chlorine is also required for the bleaching. In this country common "news" requires to have about 20 per cent. of sulphite to hold it together on a fast-running machine. In America it can be produced with 100 per cent. mechanical, the reason being that mechanical coming direct from the grinders has greater felting powers than if converted into pulp and shipped to this country. This point is a matter of considerable economical importance, and probably accounts for the difference got with fast-running machines between England and the United States of America.

I have explained that mechanical or ground wood pulp can only be used alone for inferior grades of paper, and must be used direct from the grinders on to the paper machines. A combination of about 70-80 per cent. of mechanical wood pulp fibre, and 20 to 30 per cent. of chemical produce the "news" on which our daily newspapers are printed.

The manufacture of wood pulp is undoubtedly a most interesting study which has closely occupied the minds of eminent scientists and experts for years, and new facts are being brought to light. Indeed, wood pulp as a field of research, seems inexhaustible.

Quite recently I visited the important paper and pulp mills of the Munksjö Company at Jönköping, in Sweden, where the manufacture of what is termed "Kraft" paper was discovered, tradition says by accident, although Mr. Hagborg says that the method was arrived at after long and careful experiment.

Wood pulp is used solely in the production of many thousands of tons of boards, which are used by bookbinders, paper boxmakers, and others. I might mention that in the various pulp-producing countries many millions of pounds sterling are invested in the production of pulp. A large proportion of this is British capital.

Reverting to the question of

GROUND WOOD,

or, as it is generally known in this country, mechanical, it may be said that the method of logging and of conveying the cut timber from the place where it falls into the mill, is governed largely by local conditions, which I shall deal with subsequently. But when once the wood is at the mill, the method of transforming it into mechanical wood pulp is to-day a simple one. The blocks of wood are put into a barking machine, a common form of which is provided with three knives upon a rapidly revolving drum. The blocks of wood are brought in contact with these knives, and it is essential that the bark is thoroughly cleared away, otherwise the pulp will show dark spots. Knotty wood is also objectionable, and as far as practicable, knots have to be removed, and in many mills this is achieved by means of a revolving auger or a spoon-shaped auger. The wood is cut into blocks by circular saws, and it should be finally split in order that the inside of the wood may be examined, as it is undesirable that any decayed timber shall be made use of. Only sound wood should properly be used, as the effect of rotten wood is sure to be detrimental to the pulp. The actual process of grinding the wood is simple. Every kind of machine for grinding consists of a grindstone (of sandstone), which runs at a very rapid rate, and against the surface of which the wood is pressed, the latter being kept constantly wet by a copious water supply. The wood is fed into what are termed pockets, and placed so that its vascular bundles lie parallel to the surface of the grindstone. The latter, in revolving, tears from the wood individual vascular bundles, and occasionally large splinters. The mass is carried by the water into a vat, in which the revolving stone is placed, and from there to the sorting contrivances, by which various sized particles of wood are separated from the other. In some

modern grinders, the stone is fixed to a vertical shaft, but most authorities consider a horizontal position preferable. If time permitted, I would like to have described in detail the various types of machine in use in various countries, of which the principal ones are; Voelter's, Oser's, Voith's, Freitag's, Abadie's, and others. In this connection it is highly essential that the water used shall be pure and free from suspended solid bodies, sand or clay being particularly objectionable, as they cling to the pulp, and affect it considerably when it gets into the paper-maker's hands. It is, therefore, of course, highly necessary that in establishing the site for a pulp-making centre, there shall be a suitable water supply, otherwise the water used for grinding must be carefully filtered, and in some mills where the water is not all that could be desired, the water, after it had passed through the sorting screens, is collected, filtered, and again used.

SORTING PULP,

which follows the grinding, is a very important detail. The sorter is, in fact, a kind of sieve or series of sieves, and Voith's shaking sieve is probably one of the best types in use. The frame rests on steel springs, and the cranked axle, by an ingenious arrangement, secures uniform running, whilst the sieves jerk and shake rapidly, 400-500 motions per minute. The application of springs reduces the wear and tear very materially, and also minimises the noise. The particles of brown wood, having thus been mechanically sorted, the pulp is conducted to the settling vats, the dehydrating apparatus, or the board machines, as may be desired. There are various processes for dealing with the particles of wood which would not pass through the sieve, and, generally speaking, it may be said that they are re-ground and again passed through a fine meshed sieve.

The removal of water from pulp is a very important element, which has to be taken into consideration, especially where the question of freight has to be considered; and as a considerable quantity of pulp has to be shipped over large distances, it is obvious that it is not desirable to carry more water in the pulp than circumstances necessitate. Therefore, the importance of this is a matter which has a considerable bearing on the immediate advantage which accrues to a mill in the position of making up its paper from pulp on the spot, but the full consideration of this subject is a matter which is rather outside the scope of this paper. There are many forms of drying apparatus, and the preparation of perfectly dry pulp is now quite practicable. As bearing upon the importance of selecting wood of the right class for the particular purpose intended, I may here observe that Prof. Winkler made interesting experiments with pulp from different varieties of wood, which was exposed to the action of the air at a temperature of between 30° to 50° F., and he obtained most interesting results, which are fully set out on page 42 of Bersch's book.

To those of my audience who desire to go thoroughly into the chemistry of paper-making, I can recommend a publication on this subject by R. B. Griffin and A. D. Little, published by Howard, Lockwood and Co., New York. From memory, I believe the book I refer to was published in 1894. It contains a mass of information of a very useful character. Other valuable books to those who desire to go into the matter of wood pulp thoroughly are :—"Vegetable Physiology" (Goodale), also Schubert's "Die Cellulosefabrikation," and amongst our British authorities, the writings of Mr Clayton Beadle, Messrs. Cross and Bevan, Dr. Stevens, and Mr. R. W. Sindall are amongst the most instructive; whilst the lectures delivered before this Society not very long ago by my friend, Mr. Julius Hübner, of the Manchester Technological School, also afford much information on the subject of paper-making generally, and on the treatment of wood pulp from the paper-maker's point of view.

CRUSHING.

Another interesting process in the preparation of mechanical wood pulp was known as the crushing process, and the effect is the preparation of pulp from steamed wood without the necessity of grinding. This has been known as the Rasch-Kirschner method. The steamed wood was first converted into small pieces by means of a chopping machine of special design, and then the wood was cut by a knife mechanically driven lengthways into shavings of fixed size. or lengthways as well as crossways. The small pieces of wood were then further reduced by mechanical means, having first been subjected to the action of a stamping mill, and eventually were put into the Hollander, and I am told that a very decent class of brown boards or stout wrapping papers could be made in this way, and it is stated that boards and paper especially suit-

able for roofing purposes made by this process had special advantages. Some of such boards, impregnated with coal tar, were said to be specially adapted for resisting the action of the weather, and are described as "perfectly indifferent to water as well as to changes of temperature." Attempts have been made to bleach the pulp made from steamed wood, but so far as I can learn the results were not commercially successful.

Although it may possibly, strictly speaking, be somewhat beyond the natural scope of a brief paper of this kind to go into the commercial details of wood pulp making as regards cost, I have been favoured by a gentleman who is in a special position to obtain information of this kind with some very interesting figures. I am told that it requires 80 h.-p. to make one short dry ton per day, or say, 90 h.-p. to make one long dry ton per day, so that a mill developing 1,800 h.-p. on the turbines should produce 20 tons of dry mechanical pulp per day, or say, 12,000 tons per year of 300 working days. Some Norwegian mills have very small horse-power on the stones, but the latest and most modern mills have at least 250 h.-p., whilst the Canadian mills are calculated on a basis of 300 to 350 h.-p. per stone, and very large stones are used. On the subject of the actual cost of producing mechanical pulp, I am told that a pretty reliable estimate of the cost of the wood necessary to make a ton of dry pulp is approximately:—

Dry Pulp.

In East Norway .... from	25s.	to 30s.
In North Sweden .... "	22s.	to 25s.
Canada: Lake St. John and portions of Nova Scotia	13s. 6d.	to 15s.
St. Maurice River and other districts........................	15s.	to 22s.

Wet Pulp.

The net cost, allowing for depreciation, is given approximately as follows:—

	Per Ton, Dry Weight. £	s.	d.
Modern mills in Norway, C/a......	3	0	0
Modern mills in Sweden, C/a........	2	15	0
Lake St. John	1	17	6
St. Maurice District................	2	10	0

On this subject, it should be borne in mind that the capitalisation of a modern pulp mill is very high, and for a mill making, say, in Scandinavia 6,000 tons wet, and 3,000 tons dry, f.o.b., value (roughly) £10,800, the mill capitalisation would necessarily be from £20,000 to £25,000; and hence it follows that to make 10 per cent. on the capital a net profit on the produce of from 20 to 25 per cent. is necessary.

Small mills such as these form the majority in Scandinavia; but mills of this class could not be made to pay in Canada, were the biggest mill (Chicoutimi) made 48,000 tons of short wet pulp in six months. The entire capitalisation on this basis is 27 dols. per short ton dry per annum, or, say, £6 5s. per ton dry weight (2,240 lbs. per year), making the value of a short dry ton to be 13·50 dols. f.o.b. On this basis, a good return will be shown, viz., a net profit of 20 per cent. on the article yielding 10 per cent. for the purposes of dividend.

In the matter of the general cost of good bleaching pulp, of course, local conditions here, as in the case of mechanical pulp, have a considerable influence; but I am told that good bleaching pulp may be produced at a cost net (including everything, with the exception of interest and depreciation) at about the following figures.

In Norway, at modern mills, about £6 per ton at the mill; unbleaching qualities would probably cost about 10s. per ton less. In Sweden the cost varies considerably, but about £5 may be stated for "news" pulp, and £5 10s. for bleaching; and this is, I think, a low estimate and can only be applied where the most favourable conditions are in operation. So far, practically, no success has attended the Canadian pulp mills in the manufacture of chemical pulp, and this I attribute largely to lack of knowledge of the technicality of sulphite-making, and through the lack of organisation as to timber supply. Mills have been put down where timber could be had before building for 2·50 dols. to 3 dols. per cord in limited quantities, but owing to lack of organisation and adequate security for the continuity of supply, prices have been forced up in Canada to 5 and 6 and even 7 dols. per cord, which is higher than in Scandinavia. On the subject of capitalisation, a modern mill would be doing well if capitalised so that every £5 of capital produced one long dry ton per year; but most mills are, I think, capitalised on a great deal higher basis than this, and the fact is, of course, obvious. This, however, is much better than mechanical making, as 10 per cent. net on the article will nearly always give more than enough for a 10 per cent. dividend.

The Use of Wood in Paper-making.

The first time, perhaps, that wood was used to any appreciable extent in the manufacture of paper was when Koops published his book, in 1800; but at that period it could not be made to compete successfully against rags. The European wars had the effect of raising the price of rags at the beginning of last century, so much so, that there was a law which prohibited the burial of the dead in linen shrouds.

Mechanical wood, or mechanical pulp, as we know it to-day, is, as I have already said, produced by keeping short cut pieces of wood by hydraulic pressure against the surface of a rapidly revolving stone, and was the first form in which wood was used in any considerable quantity.

Mechanical wood has very little felting power, and is only capable of producing a weak paper, which contains practically all the ingredients of the original wood, and from the time of its discovery up to the present it has only been used for lower class papers. It, however, constitutes the great bulk by weight of our paper-making materials, as a common newspaper contains upwards of four-fifths of this substance.

Chemical Pulp.

A great change took place in the manufacture of paper on the development of the sulphite process. This process consists in treating chips of wood under a pressure of about seven atmospheres with a solution of bi-sulphite of lime or magnesia for a period of from eight hours to three days. The first patent was undoubtedly taken out by Benjamin G. Tilghman, of Philadelphia, in 1867. His original specification practically covers the various methods employed by subsequent inventors. He started by boiling in lead-lined cylinders. Although an excellent fibre was obtained the engineering difficulties rendered it necessary to abandon his original process.

The preparation of wood for the chemical process is somewhat similar to that employed in preparing the wood for grinding. The wood is brought from the river or from the stacks in the mill yard, sawn into suitable lengths, passed through the barking machine, then through the knotting machine, afterwards fed into the chipping machine, which, at a great rate, reduces the wood into small chips. It is then screened, and any further knots which appear are removed, and then the wood is taken along by a conveyer from the screens to the top of the digester house, and fed into the digesters through the manhole at the top. I have seen, at the modern Chemical Pulp Mills, in Sweden, Norway, Finland, United States, and Canada, digesters with a capacity of 15 tons dry pump, and I have heard of a mill in North Sweden with a digester which will carry at one cooking 20 tons of dry pulp.

The Pioneers of Chemical Pulp.

The actual date of the invention of wood pulp is more or less problematical, as the evolution of wood pulp has undoubtedly extended over a very considerable period, but the reference to Tilghman may be accepted as established. Some years ago a very interesting correspondence appeared in *Papier Zeitung*, and Professor F. Fittica asserted that (*a*) Mitscherlich was entitled to the honour of being recognised as the inventor of sulphite. The editor of *Papier Zeitung* apparently did not wish to share the responsibility for that statement, and I think the editor of our esteemed German contemporary was well advised in the view he took, and in the course of a very intelligent correspondence, various more or less authoritative people put forward the names of Ekman, Tilghman, Rismuller, and others, and various information was forthcoming regarding priority, but the consensus of opinion seemed to controvert Professor Fittica's original argument, and *Wochenblatt* mentioned C. D. Ekman as the father of the sulphite industry. About the year 1872 a well-known publication, in discussing this particular matter, argued that it was due to Ekman that the manufacture of Mitscherlich's cellulose on a large scale was rendered chemically possible. Prof. Fittica, however, who stuck to his guns in championing Mitscherlich, said that Ekman did not operate with calcium sulphite according to Mitscherlich's process, but he used magnesium sulphite, a salt that was without value owing to its inconstancy, and, consequently, was of no technical consequence as compared with calcium sulphite, but subsequently Ekman undoubtedly made a success of the magnesium sulphite process. However, his method was kept secret so that even for that reason the same could not have been, in Fittica's opinion, used by Mitscherlich. In this connection it is worth while remembering that originally Ekman's mill was in operation from 1874 to 1897, but was, of course, re-opened later. Fittica further stated that Tilghman was ahead of Mitscherlich, in so far as he used

diluted sulphurous acid for transforming wood into cellulose, and it is significant that in the year 1886 Tilghman, in his patent, No. 2924, mentions "that an addition of bi-sulphite of calcium to sulphurous acid is advantageous." However, it subsequently appeared that he had not used the salt alone, nor did he use the comparatively low temperature recommended by Mitscherlich. Moreover, he was unable to surmount the technical difficulties combined with these stated processes, and subsequently discontinued his experiments in the year 1867, after struggling for two years, and losing 20,000 dols. or over. In the year 1882, Ritter and Kellner took out a patent, and at this time Mitscherlich's factory in Munden was flourishing, having been started in 1875, and having made considerable progress, and the friends of Mitscherlich claim that the early manufacturers, in a general and theoretical way, operated on the Mitscherlich principles, their process differing only in insignificant arrangements. Prof. Kirschner states in his work, "Zellstoff," that F. A. Rismuller was the first to produce practically valuable cellulose on a considerable scale, under Mitscherlich's direction, in his factory. The names of O. Vogel, in Zell, is also alluded to by Prof. Kirschner, but there is no evidence that Vogel played any great part in the actual invention, although there is evidence that at one time he was assistant to Mitscherlich, and subsequently Vogel put down his own plant, which was arranged according to the Mitscherlich process. In 1884, in favour of Tilghman, Mitscherlich's patent No. 4179 was suspended by the German Court, and history would support Tilghman's contention. Some reliable authorities point out that sulphurous acid and its preparations had formerly been used only for bleaching cellulose wood pulp, and as late as 1867, after the issue of the Tilghman patent, Mr. Krieg—whose opinion is worth something—emphasised the fact "that wood pulp was not suitable for fine papers." Heldt states that in 1869 sulphurous acid should not only be called bleaching material, but bad bleaching material, because it imparts a yellow colour. At about that time, apparently new methods were discovered to change the wood into cellulose by the use of alkalies, and it is recorded that in 1872 considerable progress was made in this direction. A year later, in 1873, Menzies published a new process, according to which wood was treated in the damp state with chlorine, and in that same year Aussedat seems to have paid considerable attention to bringing wood and chlorine together in steam pressure. Blyth and Suthby made combinations of both the first and last mentioned methods by first submitting the wood to the action of alkalies, and subsequently to high steam pressure, and this method was amplified and improved by Ungerer. Then Mitscherlich came into the market with a new arrangement to use bi-sulphite of calcium, and demonstrated that by a solution of calcium sulphite with strong acids, he prepared a solution of calcium di-sulphite. Following this success, and assisted by the use of Swedish Patent No. 2939, he succeeded during that year in the performance of technical trials on a large scale, and in 1875 he obtained a directly prepared solution of di-sulphite, such as he had previously obtained from calcium carbonate. At that time he obtained the action of pure calcium bi-sulphite on wood, preparing the salt by running sulphurous gas over pieces of carbonate of calcium. Afterwards he constructed a tower for making the bi-sulphite of calcium. This method seems to have been considerably followed, and in 1866 a sulphite mill was built in America on Mitscherlich's lines, and according to a report from Thilmany (1894), the Mitscherlich process had been favourably adopted, and to such an extent that about that time there were forty boilers in operation in the United States and four in Canada; and the total yearly product in the States at that time was about 50,000 tons. On turning to Muspratt's technical handbook of that time, Mitscherlich is mentioned as the inventor of sulphite cellulose. Without committing himself to Stohmann, whose opinion has been freely quoted, it is significant that this authority mentions Tilghman and others, but merely to show that their experiments, as compared with Mitscherlich's success, had no weight, since they were not performed in a practical manner, and because they gained no technical success.

Stohmann, however, was subsequently reminded that the earliest edition of Muspratt contained no mention of Mitscherlich, although his mill in Munden was then in secret operation. Prof. Fittica, on this subject, summarises his opinion in these words: "Tilghman used the sulphurous acid, or he intended to use the same; but he did not use the sour calcium salt of the acid, and did not prepare or use the same in its pure state, in which condition only is it practicable for that purpose. For this reason, Tilghman had to discontinue, after ten years of restless activity." Ekman's magnesium

sulphite, however, undoubtedly and finally proved to be a suitable preparation. Several other experimenters also failed to comprehend the action of the temperature, so that also in this respect we must give Mitscherlich the credit due to him. As might have been expected, Prof. Fittica's contentions provoked very considerable criticism, and some rather severe comments, and returning to the fray, Fittica says in 1904: In my history, in the manufacturing of sulphite stuff, I mentioned especially that it was Tilghman, besides others, who had already undertaken to make experiments to make sulphite fibre by means of sulphurous acids, but that it was Mitscherlich who provided a practical foundation to these experiments, and he must be called the first inventor in case the question arises as to a really practical invention. The germs of the idea of a new invention, a new principle, a new law, a new conception of the universe only take root gradually. Each idea has its forerunner, and these forerunners are present in every direction. . . . The person, however, who forms these ideas in the practical shape must be considered the inventor, because his forerunners have not performed a technical realisation. . . . Consequently," adds Prof. Fittica, "I repeat that it was Tilghman, besides others, who furnished the idea of manufacturing sulphite fibre, but it was Mitscherlich who added hand and foot to the practice, and, therefore, must be called the real technical inventor of the sulphite cellulose fabrication." Quite recently, Prof. E. Kirschner added a very important contribution to this controversy, and wrote that Ekman, in Bergvik, Sweden, produced regularly large quantities of the valued sulphite pulp in 1874. That was long before Mitscherlich, and Prof. Kirschner adds that Fittica did not apparently seem to be aware that magnesium bi-sulphite, and also sodium and potassium compounds, produced not only the same effects in the sulphite process as calcium bi-sulphite, but would be even preferable to the latter, were it not for the higher cost of the bases contained in the former. Prof. Kirschner went at some length to substantiate his arguments by giving interesting chemical details, and went on to observe that "seeing that Ekman, in Bergvik, had not only magnesite, but also lime close at hand, and the latter could be bought at a lower price, we are justified in concluding that Ekman was well aware of the technical conditions offered by a magnesium bi-sulphite liquor in contrast to one prepared from lime. From 1875 and onwards, Ekman pulp was to be found in European markets. Later on, in 1878-1880, the Ekman pulp was certainly of a higher quality and fetched a higher price than the impure irregular material from Hann-munden, where the Mitscherlich process was being worked." Kirschner further controverted the suggestion that the poor qualities attributed to Ekman pulp by Fittica were not justifiable, and he argued that Mitscherlich was largely a copyist of Rismuller and Vogel. To those who are sufficiently interested in the subject, a perusal of Ekman's and Francke's patent specifications for the manufacture of sulphite pulp will probably be of considerable historical interest, and I am indebted to Mr. Clayton Beadle for a perusal of the same. This patent seems rather to bear out the contention that at a certain period quite a number of distinguished men were struggling to place what we now term chemical pulp on a commercial basis, and that Ekman contributed considerably to the solution of the difficulty.

C. D. Ekman (a persevering Swedish chemist), who died last year at Gravesend, therefore appears, in my judgment, to have been the first to make a commercial success of the sulphite process. He set to work in 1872, using a solution of bi-sulphite of magnesia. His process was worked secretly until about 1879, when it was introduced into the Ilford Mills, near London; after which, in 1884, the proprietors of the patent erected large mills at Northfleet, where the process was conducted by the Ekman Pulp and Paper Company, and was finally abandoned in this country in 1903-1904, it being no longer possible to compete with foreign countries, on account of the cost of timber.

The great difficulty in the way of making the sulphite process a success was due to the corrosive action of the sulphite liquor. This liquor quickly eats through iron, and has a certain amount of action upon lead. Lead linings were at first used at Northfleet, but owing to the difficulty of "creeping," lead had to be abandoned. The "creeping" is due to the difference in the expansion of the lead and the outer lining, causing the lead to "pucker." I am informed that the first lining came away completely, like a jelly out of a mould. Many linings were substituted, among them cement. The difficulty was finally overcome by introducing a brick lining.

Wood pulp for paper-making was manufactured at Guardbridge, in Scotland, very

many years ago on the site of the Guardbridge Paper Company's mills. It was also made at Bruce's, at Kinleith Paper Mills. The Messrs. Tait have made wood pulp at their paper mills at Inverurie for over twenty years past. Then a plant was erected at Inverkeithing.

In England, Ekman made pulp at Ilford. Mr. Edward Partington, one of the most experienced authorities on wood pulp in this country—who would have been with us to-night but for the fact that he is leaving for the Continent—made pulp for years at Glossop. The Kellner-Partington Paper Pulp Company also made pulp at their mills at Barrow-in-Furness.

Mr. (now Sir John) McDougall, ex-Chairman of the County Council, made wood pulp at Millwall.

Then there was another company at Goole—which made pulp in 1890, but is now discontinued—and the West Hartlepool Company, which also made wood pulp. Some seventeen or eighteen years ago, I remember being invited to the mills of the East Lancashire Paper Company, where in a small building I saw wood pulp being made by what was then known as the Graham process.

A Scotch friend tells me that the Guardbridge Soda Pulp Mill was erected in 1870-71, and it worked for about two years or so. The boilers were of Mr. Sinclair's patent vertical, having conical ends, the fire being underneath, having spiral flue so that the gases ascended and passed through an iron-funnel chimney on the top. To prevent the burning of the wood, there was provided a perforated cage having 1½ inch space between said cage and outer shell for the liquor. There was a down-take pipe about 5 inches diameter to take down the liquor through the centre of the cage. This down-take pipe was removable, so that it could be taken out when the boiler was being filled. These boilers were 10 or 12 feet deep, and about 4 feet diameter, the working pressure being about 200 lbs. per square inch. Caustic soda was used, and the wood was boiled off in three hours.

The Goole Company commenced making pulp in 1890, but has not been in operation for some time. The North Eastern Pulp Company also turned out pulp, but is not now doing so.

Messrs. Brown, Stewart and Co. had digesters at Newton Paper Mills and at Dalmarnock Mills for making their wood pulp; but this also has all been discarded. This was about twenty years ago.

In those days the cost by Francke's process of wood and chemical plant for the production of 30 tons of sulphite pulp per week was estimated at £8,000, and with the Ekman process—then just at work at Ilford—£13,000 to £14,000 was spent on plant, machinery, and wood to produce 20 tons per week. The cost of raw wood to make a ton of paper at Hull or Liverpool was estimated at £5.

In the early days of sulphite pulp manufacture I went to Sweden and studied the bi-sulphide process at Francke's mills. Mr. Edward Partington and Mr. James Galloway about this time visiting the same mills, with the view of adopting the process. Subsequently Mr. Partington erected a sulphite wood pulp plant at Glossop, and worked a system of his own. In 1844 Keller took out letters patent in Germany for a wood-pulp grinding machine, but for want of capital sold it to Voelter. J. Macfarlane, of the Canada Paper Company, told me that he first introduced wood to the country in 1874, that he offered some bass-wood to Bruce's of Kinleith—and was laughed at. He finally offered them a farthing per pound over and above the market price for the paper; the pulp was eventually accepted, and proved such a success that the Bruces, very naturally, kept the matter to themselves as long as possible.

The Partington process acquired by the American Sulphite Pulp Company about 1884 was the first to be made use of in the United States of America. It was also conducted in this country by the Kellner-Partington Paper Company, but was, I believe, abandoned a few years ago.

Mitscherlich, who, by the way, was Professor of Chemistry of Munich, began his experiments with the sulphite process about 1876, and later on went to Thodes Mill, near Dresden, and has already been referred to. He started commercially about 1881.

Many lawsuits were fought in respect of the rival patents, which showed very close resemblance in their claims. Behrend, in 1883, disputed the validity of the Mitscherlich patents on the grounds of the priority of Tilghman British patents, and the German Board of Patents concluded that the Mitscherlich process did not differ from that of Tilghman's to entitle it to protection. There were numerous patents in connection with the lining and the digester which we need not refer to in detail.

The treatment by the sulphite process consists first of all in preparing the liquor. This is done by causing the vapour of sul-

phurous acid obtained by burning either "pyrites" (sulphide of iron) or sulphur in ovens, and conveying the vapour up from the bottom to the top of a tower of about 105 feet in height, packed with limestone—a spray of water is introduced at the top and trickles through the limestone. The vapour combines with the water to form sulphurous acid, which acts upon and dissolves the limestone, forming bi-sulphite of lime. In the Ekman process, a stone consisting chiefly of magnesia is used, whereby bi-sulphite of magnesia is produced. The liquor, standing at about 11° Tw., and containing about two-thirds of the sulphurous acid in the free state and one-third in combination with lime, is run into a sulphite digester, which is closely packed with chips of the wood until the liquor just covers over the wood. The lid is put on, steam is introduced until the temperature slowly rises to about 100° C. This causes all the air from the pores of the wood to escape and the solution to take its place, and takes a few hours. The temperature is then increased by the introduction of further steam until it slowly rises to, say, 117° C.; 115° is about the temperature at which chemical action begins to take place; 120° is the maximum temperature above which it is unsafe to go. The temperature, therefore, must be maintained within these limits during the process of boiling. The progress is judged by withdrawing samples of the liquor and examining their colour, sedimentation, and by other means. When the process is complete, the digester is blown off, the pulp washed with hot water, after which it is put into potchers, where it is further washed, and then it is passed through screens for separating out any untreated particles, and collected in the machine in the form of sheets containing 50 per cent. moisture, packed into bales for shipment.

If required in the bleached state, when in the potcher, it is mixed with solution of bleaching powder from 10-20 per cent. of the weight of the material, emptied into "steeping" tanks. When the chlorine is exhausted, the liquor is allowed to drain away, and the bleached product restored to the potchers and treated in the same way as the unbleached product.

Chemical wood pulps now enter into the manufacture of the highest class papers, and such a degree of excellence has been achieved in this that only an expert could tell the difference between a chemical wood fibre paper and an expensive all rag paper.

Soda Process.

The heating is effected either by means of coils or live steam. When the latter, allowance must be made for the amount of condensation. Little makes the statement that the temperature can be raised quickly. I have, however, reason to know that with soft soda aspen the temperature has to be raised slowly and with the utmost care, and also lowered again. The filling of the boiler is similar to that of the sulphite; the full pressure is, however, reached as quickly as possible, and maintained until the end of the treatment, the pressure formerly adopted being from 60 to 75 lbs. per square inch, but latterly it was employed at about 100 lbs. per square inch, and sometimes 110. The time of boiling is from eight to ten hours: as the pressure is increased the strength of the liquor can be somewhat diminished. Unlike the sulphite pulp that obtained by means of the soda process is of a greyish brown colour, whilst the liquor is a darkish brown and of a peculiar odour. This liquor contains the incrusting and resinous matters in combination with the soda as a soluble soap.

Caustic soda, being an expensive chemical, has to be recovered. This is effected by evaporating the liquor down to a thick syrup, after which they are made to flow into a revolving furnace, where they catch on fire, their own organic matters supplying a large amount of heat necessary for the incineration as well as for the evaporation of the weaker liquors. The evaporation is much economised by the adoption of what is known as the triple or quadruple effect evaporator, by means of which the water is removed at the least possible expenditure for fuel. The incinerated ashes as discharged from the furnace appear in greyish and blackish masses in the form of a sort of clinker. This mass, consisting of carbonate of soda mixed with carbon, is "lixiviated" or treated in hot water, whereby the soluble carbonate of soda goes into solution, leaving a black mud of charred and useless matter, from which the liquor is freed by sand filtration. The clear liquor standing at from 16-20° Tw. is heated in iron coppers, and causticised by treatment with caustic lime, whereby the carbonate of soda is converted into caustic soda, and the caustic lime into carbonate of lime or chalk. The chalk forms a sludge at the bottom of the vessel, from which the remainder of the liquor can be removed by filter pressing.

The sludge is pumped into a filter press to remove the liquor still remaining, and water

caused to percolate through to remove the last traces. A clear caustic liquor is ready to be used again in the process of boiling. The process of recovery results in a certain amount of loss of the soda, amounting to about 15 per cent. This has to be made good by the addition of a certain amount of caustic or carbonate of soda. Soda wood pulp is generally of stuff of the nature of sulphite, and though of darker colour, is, as a rule, easier to bleach. Of recent years the soda process has gone to a large extent out of use and has been replaced by the sulphate process. This process consists in treating wood chips in an iron digester with sulphate of soda containing in the first instance a certain amount of caustic. The process is conducted very much like the soda process. It is carried up to the stage of the recovery process in a similar manner; in the soda process, however, the recovered ash consists of carbonate of soda, whereas in the sulphate process the recovered ash consists of sodium sulphide and sulphate of soda. The liquor ready for using again consists of caustic carbonate, sulphide, and sulphate of soda. The process is cheaper than the soda process, because instead of making up for the loss of the soda by the addition of caustic or carbonate, it is made up with sulphate of soda, which is a much cheaper chemical; sulphate passing through the recovery process is reduced by the organic matter to sulphide; a considerable amount of this sulphide is decomposed through the treatment of the wood, giving rise to sulphuretted hydrogen. The gases emanating from a sulphate factory render it necessary to conduct the process in districts where noxious factories are not interfered with.

A great deal of the wood pulp sold as soda pulp is, I am assured by a leading expert, in reality sulphate, and he tells me the proportion appears to be increasing every year. On this subject I am unable to express an opinion, but I am quite certain the British paper-maker secures delivery of chemical pulp capable of being used for the purpose intended.

Possibilities of Wood Products.

Prof. E. Pfuhl has recently published a very interesting book on "Paper Yarn: Its Production, Properties, and Uses." In this book, Prof. Pfuhl gives an account of the progress that has been made in producing yarn from threads prepared by a wet felting of fibres, and the results are most interesting. The raw material, consisting largely of chemical wood pulp, is dealt with in a special manner in the beating engine, so as to reduce the length of the fibres to the necessary extent, and convert the whole into a good felting paper pulp. The pulp is then brought on to a Fourdrinier machine, and a layer of this pulp produced in the ordinary manner, after which it is divided into a number of narrow bands, which bands are twisted by mechanical means, and converted into threads. According to Prof. Pfuhl there are two processes in practical working. One is for the production of a material known as "xyloline" based on the patents of Claviez and Co. In this, the strips of pulp, as they come away from the machine, are wound on to reels, and these reels are then fixed to revolving forks, so that on winding the strip off the reel, it receives the necessary twist, and is mechanically treated otherwise. The material produced yields a strong yarn, and is so cheap that a complete suit of clothes can be sold for 7s. to 10s. It is further stated that it can be washed without being damaged in any way. Silvaline is also produced at Golzern-Grimma on the lines invented by Herr R. Kron. Here paper is divided into strips and subsequently spun into threads, and the machinery is very delicate and beautiful. The first factory was erected in Spain, near Bilbao, and another factory has been erected in Holland. Other factories at Rattimau and Mesterlitz, in Germany, are being erected, and the enterprise is extending to Russia, and there is no doubt that silvaline and xyloline will enter into direct competition with jute, and possibly coarse cotton yarn.

The rapidity of the progress made in this branch of technology is a marvel among modern enterprises, and it is doubtful if, in the history of the nations of the world, any one industry has achieved such a success in comparatively so short a period of time. Probably few realise what an amount of wood pulp the publication of our daily newspapers requires. I may here remark that one London "daily" has recently entered into a contract for the purchase of 10,000 tons of paper per annum for three years, and I think it would be fair to estimate that each day one of our large London daily papers consumes 10 acres of an average forest. Wood pulp owes its wide range of application to the fact that it is a material that can be made to any degree of consistency, from a delicate almost intangible fabric to a dense mass as hard

as metal. It can be dyed to any colour or shade; it can be rendered fire and waterproof; and in the hands of the chemist may be converted into a number of very useful combinations.

Ekman, it is not generally known, succeeded in producing a substance which he called "Dextrone," from sulphite liquors. This substance had special qualities. It could be mixed with glue and precipitated in the form of leather when diluted with water only. It could be used in giving strength to brown papers, in weighting jute, or as a mordant for dyes. It was of the nature of tannin, and yet it had quite distinct properties. Seeing that for every ton of chemical wood pulp produced about a ton of dextrone would be recovered from the liquors, an enormous quantity could be produced if required. This substance was not, I think, manufactured in England after the Ekman works stopped making pulp. Capt. Partington has recently made use of sulphite liquors for watering the roads, and claims to get very excellent results.

Wood pulp is now used for the manufacture of nitro-celluloses. For explosives the pulp has to be of a special nature. It is also used under the name of "Cellulose Wadding," prepared under Feirabend's Patent No. 3061, where it replaced cotton wool for surgical bandages, giving most excellent results. It is also, as Pfuhl reminds us, coming into use in the form of paper in narrow strips, which are afterwards spun into filaments and woven into garments, such as under Kellner-Turq processes and the Silvaline Yarn process. Then, of course, it is used in considerable quantities now for manufacture of artificial silk. According to the Stern process, it is converted into viscose by Cross, Bevan and Beadle's process, and then spun into fine portions through a special solution from which it emerges in the form of filaments. For this product the inventors—all three British by the way—were awarded the Grand Prix at the last Paris Exhibition. They have also received numerous other valuable awards.

In America, where they have no esparto, the printing papers for process blocks can be produced by the aid of aspen, which fibre under the soda process makes a good substitute for esparto. I think, perhaps, not sufficient attention has been paid to the subject of the great differences in the qualities of papers made from wood pulp according to the kind of pulp used and the process adopted. Thus, on the one hand, we were able to produce soft and spongy papers, excellent for filter papers, and, on the other hand, imitation parchments from Mitscherlich pulp, close, transparent, grease-proof, the latter being produced by the aid of the basalt lava beater roll.

Then we have the milk of lime process, whereby bi-sulphite liquor is now produced by passing the fumes of sulphur through milk of lime instead of by allowing it to pass up towers filled with limestone, which is the general system in use in Sweden and Noway. The liquor made by the milk of lime process is identical with that of the ordinary method, but it has the great advantage that it produces a solution of absolute uniformity in strength, a difficult thing with the limestone, but a very important thing for ensuring regularity in the cook.

Digester Linings.

One of the most important things in the history of wood pulp has been the question of digester linings. The Mitscherlich lining in 1894 consisted of tarred pitch to protect the shell, then a layer of thin sheet lead, and on top of this two courses of specially acid-resisting bricks, formed with tongue and groove, cement being used sometimes with the bricks. Some foreign mills place the lining of lead between the two courses of bricks. In a digester heated by indirect heat, a coating of the sulphite of lime can be produced on the surface, which gives a protection for the metal. Jung and Lindig used the coating of double silicate of lime and iron. Kellner took out numerous patents for cements, consisting either of ground slate and silicate of soda, or powdered slate and glass and Portland cement. One of the earliest, and one of the most successful, linings was prepared by Wenzel, consisting of a special cement, for the most part a manufacture of Portland cement and silicate of soda, set in blocks in wooden moulds made to conform to the shape of the digester. Finally, excellent results were obtained by the use of Portland cement alone, which in many cases is reinforced by a facing of special brick or tile, the usual thickness of the cement lining being 4 in. All cement linings are more or less perous when applied, but in use soon fill up with sulphate and sulphite of lime. After numerous years of work, a great many failures, a great many patents, lawsuits, and infringements, a brick has been introduced for lining which answers the purpose. Until a suitable lining could be devised, the sulphite process could not be regarded as a success. As the early

troubles with the linings made it impossible to make pulp cheaply, and the corrosion of the shell contaminated and discoloured the pulp, most of the pulp on the market now as soda pulp is in reality made under the sulphate process, which consists of a liquor containing sodium sulphate, sulphite, carbonate, caustic, which before burning to ash is fortified by the addition of sulphate of soda, the sulphate being reduced to sulphite during the process of recovery. This process is cheap, but the nauseating gases evolved during the process at one time made it a difficult matter, except in out-of-the-way districts.

Methods in the Mill Revolutionised.

I think I might point out that the introduction of wood pulp has had a considerable effect upon the way that mills are constructed nowadays in this country. Before the introduction of wood the raw materials were treated from beginning to end in the mill; now a mill buys wood pulp, which is put direct into the beaters, all the preliminary processes being obviated (except if bleached).

As to the permanency of wood papers, there is still difference of opinion. Mr. Clayton Beadle tells me he would not like to recommend even the very best bleached wood in paper required to be of an absolutely lasting character, but would give the preference to mixtures of cotton and linen. But it should be remembered that every year sees improvements in the treatment of wood, resulting in a more lasting and durable fibre. In course of time we may be compelled to alter our views.

The complete statistics bearing on the subject are much too lengthy and complicated to attempt to read in the limited time at my disposal. They will be found in the Appendix. I may, however, trouble you with one or two figures:—

In 1903, we imported into Great Britain 211,823 tons of chemical dry pulp, of the stated value of £1,842,082. This came chiefly from Sweden and Norway, and only 1,356 tons were sent to us from British Possessions. Of chemical wet pulp we introduced, in 1903, 21,279 tons almost entirely from Sweden and Norway, and value was £82,012. In the same year we imported mechanical dry, 8,268 tons, of the value of £30,192; and of mechanical wet, we imported, in 1903, 336,788 tons, of the value of £752,297.

It is worth noting that Canada supplies us with a by no means insignificant portion of the mechanical wet pulp.

In 1901, Canada sent us 48,551 tons, and in 1908, Canada supplied us with 71,664 tons of the value of £157,918. In this class of pulp, Sweden, in 1903, sent the pulp of the value of, roughly, £101,000; but Norway received £490,949 for the mechanical wet wood pulp sent to us for that year.

According to official figures, British paper makers paid:—In 1903—£1,642,082 for chemical dry pulp; £82,012 for chemical wet; £30,192 for chemical dry, and £752,397 for mechanical wet, being a total of £2,506,583.

I should be very sorry indeed to trespass on any contentious ground or to encroach on political subjects, but without taking any side in the matter I may say that in connection with the fiscal controversy, in the event of a duty being put upon manufactured articles coming into this country, it may be somewhat difficult to classify certain kinds of wood pulp in this connection. It is a rather debateable point as to whether certain classes of wood pulp are manufactured articles or not, or to what extent it may be termed "raw material." I believe Mr. Chamberlain is credited with having been good enough to look upon wood pulp as raw material, but I do not think that this is exactly a subject which is likely to cause paper-makers or pulp producers many sleepless nights in the immediate future, although the time may come when the question will have to be considered from the point of view to which I have alluded.

Appendix I.—Patents.

As will be understood, a very large number of patents have been taken out by those concerned in the development of wood-pulp making, and in importance relating to the same. The following may be taken as covering some of the most important patents from 1867, when Tilghman was granted the initial patent:—

Archbold, George. 1883; manufacture of paper pulp.

——————; manufacture of paper pulp.

Biron, Jean B. 1867; disintegrating wood to form pulp, &c.

Ekman, Carl D. 1882; treating wood.

——————; method of treating wood.

——————; treating fibrous vegetable substances to obtain fibre suitable for paper making.

Francke, David Otto. 1884; manufacture of paper pulp.

Graham, James Anthony. 1883; treating fibrous substances.

Haskell, J. R. 1867; treating and separating vegetable fibres. [Not on sulphite process, but his claim covers first steaming the fibres and then condensing steam by shower of cold liquor so as to force liquor into the wood, as in later patents of Mitscherlich.]

Kellner, Charles. 1886; method of sizing paper to prevent the sulphite and ground pulp from turning yellow. [He precipitates the rosin size with a sulphite salt.]

Minthorn Daniel. 1885; treating vegetable fibre.

Mitscherlich, Alex. 1886; boiling fibres with sulphite.

——— 1886; paper pulp (process for manufacturing).

——— 1889; manufacturing thread from short fibre.

Pictet, R. P. 1885; manufacture of pulp from wood matter.

Pond, Goldsburg H. 1886; manufacture of paper pulp from wood.

——— 1886; machine for manufacture of wood pulp.

——— 1886; manufacture of wood pulp.

Ritter, Eugen Baron, and Carl Kellner. 1885; apparatus and manufacture of cellulose from wood.

——— 1885; progress of manufacturing cellulose.

——— 1886; progress for manufacturing sulphites.

Tilghman, B. C. 1867; treating vegetable substances for making paper pulp.

——— 1869; progress of treating vegetable substances to obtain fibre.

Wheelwright, Charles S., and George E. Marshall. 1884; apparatus for treating wood.

II.—The Pulp Imported into Great Britain during the month of April, 1905, was:—

Quantities.

	Month ended 30th April.			Four Months ended 30th April.		
	1903.	1904.	1905.	1903.	1904.	1905.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Mechanical:—						
Dry	473	228	628	2,284	2,548	2,168
Wet	26,666	19,145	15,770	81,953	86,597	60,538
Total	27,139	19,373	16,398	84,237	89,145	62,706
Chemical:—						
Dry	14,226	11,478	13,650	51,983	46,215	53,149
Wet	3,745	1,859	985	7,949	8,049	6,260
Total	17,971	13,337	14,635	59,932	54,264	59,409
Total of Pulp of Wood ..	45,110	32,710	31,033	144,169	143,409	122,115

Value.

	Month ended 30th April.			Four Months ended 30th April.		
	1903.	1904.	1905.	1903.	1904.	1905.
	£	£	£	£	£	£
Mechanical:—						
Dry	2,348	1,047	3,141	12,273	12,443	11,058
Wet	60,515	42,412	36,244	191,135	189,874	140,230
Total	£62,863	43,459	39,385	203,408	202,317	151,288
Chemical:—						
Dry	111,340	90,587	115,076	411,132	362,507	443,869
Wet	13,761	7,278	3,193	30,607	30,800	25,353
Total	£125,101	97,865	118,269	441,739	393,307	469,222
Total declared value of Wood Pulp ..	£187,964	141,324	157,654	645,147	595,624	620,510

III.—GREAT BRITAIN.

IMPORTS OF WOOD PULP COMPILED FROM THE BLUE BOOK OF ANNUAL STATEMENT OF TRADE, YEARS 1901, 1902, 1903.

	Quantities.			Value.		
	1901.	1902.	1903.	1901.	1902.	1903.
Chemical, Dry.	Tons.	Tons.	Tons.	£	£	£
From Russia	—	2,404	3,907	—	18,443	29,906
,, Sweden	84,955	102,174	127,510	746,237	824,825	971,665
,, Norway	52,161	57,413	62,446	457,074	466,213	490,354
,, Germany	2,324	3,870	5,362	21,950	32,665	45,843
,, Holland	3,535	5,309	4,669	35,000	46,776	40,615
,, Portugal	1,635	1,576	1,884	13,908	12,984	14,521
,, United States of America	7,500	2,878	3,785	63,491	23,848	31,254
,, Other Foreign Countries	2,984	695	904	25,640	5,591	7,179
Total from Foreign Countries	155,094	176,319	210,467	1,363,300	1,431,345	1,631,337
From British Possessions	18,707	9,124	1,356	154,742	76,210	10,745
Total	173,801	185,443	211,823	1,518,042	1,507,555	1,642,082
Chemical, Wet.						
From Sweden	5,638	4,587	4,908	36,986	20,994	19,908
,, Norway	8,383	8,358	16,339	42,371	42,281	62,846
,, Other Foreign Countries	351	216	32	3,151	1,929	158
Total from Foreign Countries	14,372	13,161	21,279	82,508	65,204	82,012
From Canada	774	—	—	5,322	—	—
Total	15,146	13,161	21,279	87,830	65,204	82,012
Mechanical, Dry.						
From Sweden	4,122	3,957	3,067	31,500	23,861	13,557
,, Norway	2,464	2,394	2,278	16,784	12,539	10,785
,, Germany	75	55	36	421	397	224
,, Holland	710	858	245	5,605	8,450	2,258
,, United States of America	3,789	1,727	160	27,667	11,743	1,022
,, Other Foreign Countries	62	100	464	337	550	2,288
Total from Foreign Countries	11,231	9,091	6,250	82,314	57,540	30,134
From Canada	2,078	2,012	13	14,503	8,740	58
Total	13,309	11,103	6,263	96,817	66,280	30,192
Mechanical, Wet.						
From Sweden	8,847	32,014	46,000	27,929	73,203	100,863
,, Norway	187,386	211,196	217,933	532,942	516,059	490,949
,, Other Foreign Countries	87	—	1,191	295	—	2,567
Total from Foreign Countries	196,320	243,210	265,124	561,166	589,262	594,379
From Canada	48,551	72,635	71,664	137,789	169,420	157,918
,, Other British Possessions	1,328	247	—	4,440	494	—
Total from British Possessions	49,879	72,882	71,664	142,229	169,914	157,918
Total	246,199	316,092	336,788	703,395	759,176	752,297

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that the author had given a most interesting history of the manufacture of wood pulp, one of the important and necessary factors in paper-making. Not very long ago paper was produced almost exclusively from rags, from linen rags especially; and perhaps even to-day the best paper was made from that material, except that produced by that most ingenious people, the Japanese. He had seen examples of Japanese paper which excelled anything produced in this country, it being possible to split a sheet of thin Japanese paper into two leaves. The Japanese excelled in so many things, as people in the West had learned within the past few years, that one was not surprised to find that even in paper-making they were, in some respects, in advance of England. In referring to the sources from which wood for pulping purposes was secured, the author had referred to Scandinavia, other parts of Europe, and Canada. In Canada there was one Federal Government and nine or ten provinces, in four of which the forests belonged to the province and not to the Federal Government. In the other provinces, and in that great district which was formerly under the control of the Hudson's Bay Company, or Rupert's Land, the quantity of wood which could be obtained was, he believed, almost without limit. The author had advocated that some means of replanting should be adopted similar to those carried out in Scandinavia; and probably he knew that a Department of Forestry had been established in the country which was giving considerable attention to the subject. But Canada was in a somewhat different position from Scandinavia. There was a very considerable emigration from Scandinavia every year, while on the contrary, in Canada, especially in the North-West, the immigration was very large indeed, so that, to a great extent, it was necessary to clear the forests in order to produce the millions and millions of bushels of wheat which were grown, and came in large quantities to this country. He had no doubt that in a very few years Canada could send wheat in sufficient quantities into the United Kingdom to supply the requirements of the whole of the people of the Mother land. He did not wish to trench upon politics, but he knew that the people of Canada as a whole were most anxious to have the closest possible relations in trade and other respects with the Mother country. It had already given a preference to England, reducing the duties on almost everything imported from this country by one-third compared with foreign countries, and it was anxious to continue that preference. There were already a number of large pulp and paper mills in Canada, but they were few compared with what there would be in a few years; and Canadians would gladly welcome English people with means who would go over and help in producing in larger quantities what he believed was as good wood pulp as was to be obtained from any country. Canada, with its vast forests, which were one of the most important assets of the Dominion, was capable of producing timber and pulp to a greater extent than any country, even the United States. A calculation had been made that in the Province of Quebec alone there were forests equal to 190 or 200 millions of cords of wood. Last year one million cords of wood were exported from Canada to the United States, the advantage of which could have been secured by English people if they had only gone to Canada and erected mills for the production of pulp. Canada desired to be on the most cordial terms with their cousins in the United States, and they happily were so now; but the people of Canada liked to see their friends from the Mother country coming and sharing in the profits, instead of allowing so much to go out of the family, and where they would be welcomed, not as strangers or foreigners, but as their own people. The paper had been most interesting and instructive, and he was sure all the members were under very great obligation to the author for enlightening them on a subject of such importance. Canada also excelled in its water-power over any other country, and the principal falls were all used for industrial purposes. Even hundreds of miles away from what was called civilisation, in the interior of Labrador, pulp companies were at work cutting down the forests and converting the wood into pulp.

Mr. CLAYTON BEADLE thought the author had done justice to the various inventors who had severally and collectively made the industry so great a success. Too much stress had, however, been laid on the work of the first inventor, Tilghman, who only went so far as to make use of sulphurous acid. In addition to the use of that acid, and getting somewhat indifferent results, he foresaw the possibilities of making use of it in conjunction with various bases, and in his specification he protected various bases in conjunction with sulphurous acid; but it was left to the great men who followed him—Franke, Mitscherlich, Kellner-Partington and Flodgvist—by the employment of the same bases, to make it a realisation. He had taken considerable interest in one aspect of the subject, viz., in so far as it affected the manufacture of mechanical wood pulp. On different occasions he had collected information as to the amount of power consumed in reducing various classes of raw material to a condition suitable for the paper machine, which told an important tale. The material which required the least expenditure of power to reduce it to the condition of pulp was chemical pulp, mechanical pulp requiring six, seven, or eight times the amount of power; and in the intermediate class, such products as manilla and jute required double the amount, and linen somewhere about four or five times the amount. There was, therefore, the curious anomaly that the substance which was the very cheapest for the manufacture of

paper required the greatest amount of expenditure of energy for its production. However well provided a country might be with timber suitable for the manufacture of mechanical pulp, even if it was to be had for the asking, it would be impossible to convert the wood into such pulp if the country were not endowed with large water-falls, because the cost of conversion was so enormous as to render it commercially impracticable. For instance, in a country where a power had to be developed by means of coal for steam raising, the cost would be between 20 and 50 times greater than where water-falls were harnessed and used for the purpose. It was a *sine qua non* that the country must not only have the available supplies of timber, but also the water-power for the profitable conversion of wood into pulp; and when all the water-falls were harnessed and made use of for the industry, then the country had reached the end of its tether. That state of affairs would, he thought, be brought about in Norway and Sweden, before many years; but in no part of the world was there a greater amount of water-power available for the conversion of wood into mechanical pulp than in Canada. The prospects in that country were, therefore, very encouraging.

Mr. R. W. SINDALL said he understood, from reliable records, that 38 per cent. of Canada, amounting to 1,400,000 square miles, 12 times the area of Great Britain and Ireland, was timber land, so that there was still plenty of wood in the country. With regard to the important question of replanting, the Canadian Government were waking up to the fact that the forests should be regarded as a kind of Bank, or capital, from which only the interest should be drawn in the shape of mature trees. In earlier years the Government sold the right to cut over a certain area for a given number of years, and obviously it was to the interest of the firm operating in that particular locality to cut out as much timber as they could in the time regardless of those who were to follow. If some system were adopted for licensing the locality he thought the difficulty would be overcome. The Government had now issued strict regulations in regard to the cutting of timber; for example, they would only allow trees of a certain diameter to be cut down, and stringent regulations as to fires, and so on were also laid down, the result being that it was to the interest of a firm to operate in an intelligent and scientific manner. The authorities at the Bureau of Forestry in Quebec were alive to the facts of the case; and one might be sure there would always be plenty of wood in Canada provided only the interest of the Bank, in the shape of mature trees, was drawn. It might be of interest if he stated that out of every ton of wood put into a digester to make chemical wood pulp, 50 per cent. of the weight of the wood went down the drain in the form of useless liquor; so that the energies of chemists and others should be devoted to making some use of the by-products, in that way saving some of the tremendous waste which at present existed. If the Government, or some association of manufacturers established a laboratory in which investigations of that nature could be carried out, vast strides would be made in the manufacture of wood pulp and its allied products. At present very little use was made of the liquor, and the time was fast approaching when the question must be taken in hand. If the Government took some action it would soon be apparent that the manufacture of wood pulp had yet much to accomplish. As a matter of fact, very little was known about wood pulp. Although manufacturers had had 30 years' experience, a paper had yet to be made from wood cellulose showing the lasting quality of paper made from rags. There was no reason why that should not be accomplished, and he hoped, as a result of the paper, greater interest would be taken in the subject than had hitherto been the case. The daily issue of a halfpenny paper, with a circulation of 200,000 copies, consumed no less than 200 trees in the preparation of wood pulp. Fortunately, however, they would re-appear some day in another form; the papers would be burnt, and the carbon in them be given out as carbonic acid gas, which would be absorbed by the trees; so that the paper would go back into the forest as wood, and come back again a few years hence in the form of a newspaper.

Mr. L. GASTER inquired whether the author could give the value of the finished product compared with the value of the raw material, because by that the cost of the energy used in its conversion would be obtained. He thought Mr. Beadle's estimate when he said that to develop power by means of coal would cost from 20 to 50 times more than where the power of waterfalls could be utilised, was somewhat exaggerated. In his experience five or six times was nearer the mark.

Mr. PHILLIPS, in reply, said the question of the finished product was extraneous to the subject under discussion, and would involve a paper almost as long as the one he has given.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his interesting paper, said he thought a great and good work was being done by the Society in encouraging gentlemen like Mr. Phillips to read papers on subjects of such universal interest.

The resolution having been carried unanimously, Mr. Phillips briefly acknowledged the compliment, and thanked Lord Strathcona for his kindness in taking the chair.

AUSTRALIAN LABOUR COLONIES.*

The various States of the Commonwealth, in their eagerness to attract an agricultural population, are offering every facility for intending settlers, especially those desirous of forming communities based on the co-operative principle. In New South Wales the State Minister for Lands may set apart certain areas for the purpose of establishing labour settlements. A settlement is placed under the control of a Board, which enrols such persons as it may think fit to become members of the settlement; makes regulations concerning the work to be done; apportions the work among the members; and equitably distributes wages, profits, and emoluments after providing for the cost of the maintenance of the members. Any trade or industry may be established by the Board, and the profits apportioned among the enrolled members. A Board is constituted as a corporate body, with perpetual succession and a common seal, and the land is leased to the Board as such, in trust for the members of the settlement, for a period of twenty-eight years, with right of renewal for a like term. When a Board has enrolled such a number of persons as the Minister for Lands may approve, it may apply for monetary assistance on behalf of the members of the settlement. The Minister has power to grant an amount not exceeding £25 for each enrolled member who is the head of a family dependent upon him; £20 for each married person without a family; and £15 for each unmarried person. On the expiration of four years from the commencement of the lease, and at the end of each year following, eight per cent. of the total sum paid to the Board becomes a charge on its revenues, until the total amount advanced, with interest at the rate of four per cent. per annum, has been repaid. In Victoria, areas of land, not exceeding 1,500 acres in extent, may be set apart for the purpose of labour colonies, to be vested in five trustees, appointed by the Governor. For the purpose of aiding the trustees, provision is made whereby persons subscribing to the funds of such a colony may annually elect a committee of management, consisting of four members. The joint body (trustees and committee) is empowered, on a day determined in each case by the State Minister, to admit to such a colony any person who shall be entitled to such benefits as the rules of the colony may prescribe. The trustees and committee of each colony must establish and conduct the same; and they have all the powers and authority necessary to enable them to improve the position of the colony and make it self-supporting. They may establish and maintain any industry they please, and dispose of the proceeds thereof. A subsidy of £2 for every £1 received by the trustees and committee from public and private subscriptions is payable by the State Government. The moneys received being disbursed in the payment of allowances for work to persons employed in the colony; in the construction and maintenance of necessary buildings; and in purchasing provisions, clothing, building materials, stock, seed, and agricultural implements. In Queensland, the area granted to a colony, which must not exceed 10,000 acres in extent, is vested in five trustees, who are empowered to establish and manage any trade or industry. A subsidy not exceeding £1,000, either conditionally or otherwise, may be granted to a labour colony from Parliamentary appropriations for such purposes. In Victoria, special facilities are afforded for the establishment of village settlements, a sum of £67,379 having already been granted in aid of those which have been formed. The area occupied comprises 57,588 acres, and improvements to the value of £254,955 have been effected. The number of settlers actually residing on the 30th June, 1904, was 1,758, and the number not residing, but improving their holdings, 133, making a total of 1,891 in occupation. The number of persons, including wives and children, residing on the date indicated was 8,536. In Queensland, special provision is made by law for the settlement of little communities, so that settlers may live together in townships for mutual convenience, on allotments not exceeding one acre in extent, and with farms of 80 acres in close proximity to their residences. The freehold of these farms may be secured generally on the same terms as those upon which agricultural farms not exceeding 160 acres in area may be acquired, with the additional privileges that residence on an allotment in the township is held to be equivalent to residence on the farm, and one-fifth of the required improvements may be made on the allotment. Ample provision for the establishment of village settlements is also made in South Australia and in Western Australia, where there is an abundance of land well adapted for farming and orchard purposes.

* Communicated by Mr. John Plummer, of Sydney, New South Wales.

TUSCAN OLIVE OIL.

According to the Acting British Consul at Leghorn, the last oil crop has not come up to the expectations entertained during the early part of last year. The yield of oil may be safely put at less than half a full crop, possibly not much more than one-third. Some of the chief producing districts, such as Calci, Montemagno, and Lungomonte, in the province of Pisa, famed for the high quality of their produce, have had but a bare fraction of a crop. The olive-growing districts of the adjoining province of Lucca have been much more favoured in this respect, and, indeed, the bulk of this season's crop has come from this source. On the other hand, a favourable circumstance has been the almost complete absence of the olive fly, hence the fruit has been gathered in general in perfectly sound condition, and oil of choice quality has been obtained, such as fully to maintain the supremacy of Tuscany over all other oil-producing centres. Riviera and Apulia oils are considered to come next to Tuscan in order of merit, though a

good way behind. The lower cost of these oils causes them to be preferred to Tuscan in some markets where price and not quality is the chief consideration. The Nice olive oil trade is based chiefly upon Apulian (Bari) oil. French sardine packers in general make use of Bari oil in their trade, and when the sardine fishery is good, buy large quantities of it. The cheaper brands of sardines, find Bari oil too expensive, and resort to the inferior growth of Tunis. It used not to be so in former years. Up to the time of the Franco-German War French buyers habitually bought largely in Tuscany, and especially oil of the highest quality, for which they paid liberal prices. But from that period dates a declension in the demand, until, at the present time, French buyers have become conspicuous by their absence. Cheapness has become the characteristic of the French market in the present day. Notwithstanding these adverse circumstances, Tuscan, or, as it is often called, "Lucca" olive oil, still holds its own in the markets where high quality is appreciated. A lower standard of value has been established, but still it commands from 20 to 25 per cent. more in value than Riviera or Bari oils. The lower cost of the latter leads to their being used often to blend with the cheaper sorts of Tuscan oil, the compound no doubt passing as "Lucca oil." Shippers of repute, with a well-established trade, and whose brand is accepted as a guarantee of quality, will not resort to this practice. But the case is different with those less favourably situated who are compelled to compete for orders in the open market, which generally means that the lowest price secures the business. In these cases the quality must of necessity be made to suit the price, and hence the necessity of resorting to "blending." Exports of Tuscan olive oil to the United States, of late years, have shown progressive expansion, notwithstanding the heavy customs duty levied in that country, and the competition of the home-grown article. As to the latter it may be observed that, in the judgment of connoisseurs, it can never compete with the produce of Tuscany in regard to quality. The flavour and delicacy of the latter are entirely wanting in the growth of California. This is not surprising, seeing that the climatic conditions of the two regions are so different. Latitude has great influence upon the fruit of the olive tree. Olive oil grown in sub-tropical climates is characteristic of its own, amongst which may be noted the absence of any pleasant flavour, less fluidity than the growth of temperate localities, and a liability to turn rancid very rapidly. Even the relative proportions of the various constituents of olive oil vary very greatly in the two cases. Now Tuscany has a distinctly temperate climate, but it may be remarked that the olive growing districts of California are situated in the same latitude as Tunis and Morocco. In the last two countries the olive is very largely cultivated, but its produce ranks very low in the scale of quality. The demand from the English market, on the other hand, keeps stationary at best. There seems to be a greater appreciation in America of olive oil of fine quality than in England, where there is rather a prejudice against its use as an article of food, except perhaps, amongst the travelled classes. Ignorance of the great dietetic value and wholesomeness of fine olive oil can alone explain why it should be so. Italian medical authorities, as well as those of other countries, who have investigated the subject, pronounce olive oil, when pure and free from taint or rancidity, to be quite as nourishing as, and more wholesome and easily digested than any other form of fat, whether of animal or vegetable origin.

CARE OF THE AGED IN FRANCE.

For more than half a century the French Government has been experimenting with schemes for establishing old age pensions, the first Act having been passed on June 18th, 1850. The plan then tried was not profitable, for Government allowed investors 5 per cent., which was more than it could itself get, and the rate of interest had to be reduced. Shortly after the war with Germany, in 1873, the number of depositors had greatly increased, and in 1882 there was a deficit of about £1,680,000. To make up this the Government in 1884 made over to the Caisse des Rétraites a sum of about £11,300,000 on Government stock, the interest on which, with a small annual grant, amounting in all to about £500,000 would, it was calculated, meet past and present losses, and in 1895 the Act at present in force was passed, but the question is still one that gives the Minister of Finance much anxiety, and it is not unlikely that some future change will be made. At the present time deposits are received from any person regardless of age, but the amount may not exceed £20 in the course of a year. An account may be opened, says the American Consul-General at Paris, for a child of three years of age; a married woman may deposit money without her husband's consent. At any age between 50 and 65, or earlier in case of permanent disability to work, the depositor may claim his annuity, which is calculated according to the amount of his deposit and interest, and the probabilities of life, but the annuity may not exceed £48. In rural districts the tax-gatherer is empowered to receive deposits, and in many factories a certain percentage is deducted from the wages and paid to the Caisse in the workman's name. A branch of the Caisse may be founded in any town or village, with the permission of the prefect of the Department, and there are about 2,300 of such branches, with nearly 340,000 depositors. There are several large institutions for the care of the indigent aged. Some of these are free and at others a certain charge is made for board and lodging. The free ones are—Bicetre (for men only, including 640 lunatics and 200 idiot or epileptic children), 2,664 beds; Salpetrière (for women), 3,891 beds; Incurables, (men and women), 2,147 beds; Brevannes (incurables), 100 beds; Hospice Lenoir (over 70 years of age or incurable), 142

beds; Brezin (a private foundation for persons in the iron trade only), 330 beds. There is an institution known as the "Ménages," at Issy, near Paris, for widowers, widows, or married couples, of whom both are over sixty-five years of age who have been married at least fifty years. Several persons pay £10 a year for board and lodging, married couples £12 each, including separate bedrooms. There is accommodation for 1,461 inmates. At the La Rochefoucauld Hospital a charge is also made of £10 for old people who are in tolerably good health, and £12 10s. for those who have lost the use of a limb. There are many small institutions founded by private persons for old officials at some of which the charge is as high as £10 a year. Some religious orders still shelter a few aged persons, either gratuitously or at a small sum per annum.

THE MINERAL RESOURCES OF CUBA.

The minerals most abundant in Cuba are asphalt, copper, iron, and manganese. Of asphalt, there are rich beds to be found in the provinces of Havana and Pinar del Rio. In Havana province are the mines known as Jesus del Potose and Santa Rosa, situated a little more than a mile to the south of Campo Florido. The Angela Elmira mine at Bejucal, in the province of Pinar del Rio, and the Rodas Concepcion and Magdalena mines are situated at the inner end of the Bay of Marial. At Bahia Honda the Santa Elena mine has a reputation for excellent asphalt; so has the Union mine at Guanajay. In Sancti Spiritus are several asphalt mines. The ones best known are the Poza Colorado and Amparo mines. According to the International Bureau of the American Republics, considerable quantities of asphalt have been exported from Cuba, and as its quality is well spoken of, an increase in exports is anticipated. There is scarcely any metalliferous locality in Cuba where copper is not found in greater or less quantity. In Pinar del Rio mention should be made of the Buenas Aguas, Recompensa, Unión, Caridád, and the Cuba Western copper mines. In Havana province are the old mines of Bacuranas, and others at Jaruco and Minas. In Matanzas province a number of copper mines have been located. In Santa Clara Province valuable beds of copper have been found near Ciénfuegos and Santa Clara city. The most important of the old mines are those known as San Fernando and Santa Rosa from which excellent ore has been taken. In Puerto Principe province are the mines of Bayatabo between the cities Puerto Principe and Nuevitas, also the Marion, the San Antonio del Cerro, and the Cubillas mines. In all these mines the prevailing ore was carbonate of copper, the extraction of which was found comparatively easy because it is found at no great depth. The most important province, however, for copper mining is Santiago de Cuba. The town of Cobra is built on very extensive beds of copper ore, which is also found at Bayamo, Sierra Maestra, Las Tunas, Holguin, and Jiguani. Competition from the mines of Chile and Rio Tinto, as well as those in the region of Lake Superior, has acted as a drawback to the copper mining industry of Cuba, particularly as low grade ore has never been handled successfully there. Iron and manganese mines are of most importance at present by reason of their being worked regularly and on a large scale in the province of Santiago de Cuba. In the province of Santa Clara several gold mines of more or less importance are said to have been located, the most promising perhaps being the Meloneros mine, near the village of Guaracabuya, in the district of Placetas. In the district of Holguin, old gold claims have also been reapplied for, but nothing can be definitely stated as to the cause of their previous abandoment, nor in fact, as to date of their working which, by some, is said to be as far back as the time of the aborigines. The only marble of importance is that which is found n the two mountains, east and west of Nuera Gerona, on the north coast of the Isle of Pines. The marble is of good quality, ranging from a good white statuary stone through various shades of blue veined to dark grey. Specimens with pinkish tints are also found. Some of the marble is reported by experts to be suitable for the finest statuary, the colour being of the purest white. Other varieties of different hues are suitable for ornamentation and art, and they cake on a good polish. The stone is free from cracks, and will furnish slabs of any size, the deposits varying from five to twenty-five feet in thickness, and being so situated as to meet all requirements of convenient and economical transportation to points of spipment on the coast. A salt deposit exists near Salinas Point, Isle of Pines. From this point to the third Salinas Point there are large, clear, salt pits, without trees, easy to work, and which increase in width for some distance.

UNITED STATES TRADE-MARK LAW.

The new United States trade mark law came into effect on April 1, 1905, giving the country, according to *Commercial America*, the first satisfactory protection ever afforded for industrial property of this character. It may be regarded as somewhat strange that the United States has not, until this time, had an adequate law of this kind. This is due, however, to the peculiar historical development of the country. The growth of the value of trade marks is a matter of comparatively recent origin, and for a long time there was no demand for any federal law affording protection of trade marks, the State laws being adequate for all practical purposes.

The old trade mark law of 1881 has for years been regarded as more or less unsatisfactory, but it is significant that not until a decision handed down by

the Supreme Court in November of 1903, was the scope of the old law clearly shown. When it was pointed out by this decision that the old law had effect, not in inter-state trade, but only in cases of marks used in foreign commerce and with Indian tribes, it was at once seen that a new law was immediately necessary. Trade marks in the United States have, within the past few years, assumed in many cases very large value, and the fact that there was no law to guarantee the integrity of these values created consternation among the owners of property of this character.

The general opinion concerning the new law is that it is very well framed and that it is well designed to meet the main requirements of legislation of this kind. To foreigners are granted the same privileges which are given to Americans, provided that the Government of the applicant accords similar protection to the citizens of the United States, and also provided that the mark has previously been registered in the country of origin. The general provisions of the law are such as have been shown by recent developments to be the principal requirements for guaranteeing the necessary protection. The registration fee has been reduced to a merely nominal sum.

GENERAL NOTES.

FOREIGN POPULATION OF CHINA.—According to the latest statistics, the number of foreign commercial firms in the principal treaty ports and in the large cities of China open to foreigners was 1,297, and the number of foreigners residing there was 20.560. England heads the list with 420 firms and 5,662 persons; Japan comes next with 361 firms and 5,287 persons. These two countries have three-fifths of all foreign houses in China and more than half of all foreign residents. Germany has 159 firms and 1,658 persons. The United States has only 114 firms but 2,542 persons. France comes fifth with 71 firms and 1,213 persons. That Portugal in the number of Portuguese, 1,930 residents, exceeds even Germany, is accounted for by her possession of Macao; the number of Portuguese firms is only 45. Spain has 39 firms, Russia 34, Italy and Austria 18 each, the Netherlands 15, Denmark 10, Norway 7, Belgium 3, and Sweden 2.

THE COURSE OF PAUPERISM.—A White Paper just issued (60.—II.) brings down the pauperism returns for England and Wales to the end of March last. Dealing first with London, its rate of pauperism, which stood at 27·6 per 1,000 of the population in January, 27·8 in February, and 26·6 in March, 1905, showed throughout the quarter a considerable increase over the rates in the corresponding period of the previous year. At the end of March the ratio per 1,000 inhabitants of indoor paupers was 16·4, which is higher than in any previous year given in the return, that is to 19 since 1865. The ratio per 1,000 of outdoor paupers was 10·2, which is higher than in any year since 1895, when it was 12·8, and the ratio per 1,000 of indoor and outdoor paupers combined was 26·6, which is higher than in any year since 1875, with the one exception of 1895. Taking England and Wales as a whole, the returns show that the ratio of indoor paupers was 7·4, the highest in the Tables, which begin with 1865, and the ratio for 1,000 of outdoor paupers was 16·5, the highest rate since 1898. The total of indoor and outdoor for England and Wales was 23·9, the highest since 1896. Examination of the comparative statement of the number of paupers in receipt of relief on the 25th March, 1905, and the same date in 1904, shows an increase in the Eastern district of the metropolis of 18·4 per cent.; in the counties the greatest increase, 11·5, is in the Eastern district, which contains the union counties of Essex, Suffolk, and Norfolk, with a population of 2,000,644.

SPANISH SALT PRODUCTION. — The salt industry of Spain is daily extending its sphere of operations, and besides supplying domestic wants, estimated at 300,000 tons annually, exports considerable quantities, amounting in 1904 to 350,000 tons, an increase of 58,584 tons over the preceding year. According to the "Diaris de Cadiz," this production admits of a still greater development, if the public authorities help to keep the ground clear of all encumbrances, which must prove fatal to a commodity whose selling price is so low. The industry placed upon a new basis, governed by modern systems and processes, is capable, it is said, of having an era of prosperity never before experienced by it. There are in Spain to-day, 209 concessions of rock-salt works, extending over an area of 6,803 acres, of which number 54 are in operation and 155 are idle. The territory covered by the former is 2 385, by the latter 4,418 acres. Spanish salt production, compared with that of the rest of the world, ranks sixth in importance, being exceeded by that of the United States, England, Germany, France, and Austria-Hungary. So far, Spanish salt has been admitted into the markets of Uruguay, Newfoundland, Russia, Argentina, Sweden, Brazil, France, Cuba, Norway, Belgium, England, the Netherlands, and countries of minor importance, where it is regarded as unequalled for salting and tanning hides. The salt works of Cadiz alone have contributed 63 per cent., or 221,657 tons, to the total exports of 1904, other parts participating to the extent of 128,349 tons. The average production of the sea-salt pans is 300,000 tons, a quantity which could be much increased if modern alterations were made and certain tracts now lying idle were made productive.

MINERAL WEALTH OF CEYLON.—The results of the Ceylon Mineral Survey of 1903-4 have just been published. During the time this survey was under preparation, periodical reports and specimens of the minerals were forwarded to the Imperial Institute. Seven such reports and numerous specimens were received. Various ores of iron, manganese, and copper have been examined, besides thorium and cerium, both of which are used in the making of incandescent gas mantles. Many other minerals were sent, such as graphite, mica, kaolin, asbestos, limestone, and some gem stones. Unfortunately there are no coal deposits, and so the iron and steel industry will not, in all probability, grow up in Ceylon in the near future, neither, in the opinion of Professor Dunstan, will there be much iron ore exported. Of the other minerals, the samples were too small and not obtained from a great enough depth to give adequate information. The survey has discovered a new mineral, which has been called "thorianite." This is also of use in incandescent gas lighting. Thorianite may command in the English market about £30 per cwt. This discovery is not so important as it at first seems, for not more than a few tons of this mineral are likely to be obtained at present. Of course, a careful investigation as to the distribution and quantity of thorium and allied minerals in Ceylon is still being proceeded with.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

MAY 24.—"Modern Lightning Conductors." By KILLINGWORTH HEDGES, M.Inst.C.E., Hon. Sec. to the Lightning Research Committee. J. GAVEY, C.B., Engineer-in-Chief to the Post Office, will preside.

COLONIAL SECTION.

Tuesday, at 4.30 o'clock:—

MAY 23.—"The Cape to Cairo Railway." By SIR CHARLES H. T. METCALFE, Bart., M.Inst.C.E. The DUKE of MARLBOROUGH, K.G., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

HENRY WILLOCK RAVENSHAW, Assoc. M.Inst.C.E., Mem.Fed.Inst.Min.Eng., "The Uses of Electricity in Mines." Two Lectures.

LECTURE II.—MAY 22.—Alternating and direct currents — Precautions — Enclosed motors — Home Office rules—Costs—Typical and historical plants described.

The lecture will be illustrated by lantern slides.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Henry Willock Ravenshaw, "The Uses of Electricity in Mines." (Lecture II.)
Geographical, University of London, Burlington-gardens, W., 3 p.m. Annual Meeting.
Camera Club, Charing-cross-road, W.C., 8½ p.m. Mrs. French Sheldon, "Experience in the Congo."
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Sgr. Cavaliere W. P. Jervis, "Minerals and Metals of the Old Testament."

TUESDAY, MAY 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Sir Charles H. T. Metcalfe, "The Cape to Cairo Railway."
Royal Institution, Albemarle-street, W., 5 p.m. Rev. Henry G. Woods, "Velasquez." (Lecture I.)
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m. Dr. T. Holland, "Röngten Rays in Medical Work."
Anthropological, 3, Hanover-square, W., 8½ p.m.
Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. E. R. Holmes, "Medicinal Plants, Old and New."

WEDNESDAY, MAY 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Killingworth Hedges, "Modern Lightning Conductors."
Geological, Burlington-house, W., 8 p.m.
National Service League (in the Rooms of the United Service Institution), Whitehall, S.W., 3½ p.m. Lecture by Mr. Diosy.
Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.
Linnean, Burlington-house, W., 3 p.m. Annual Meeting.

THURSDAY, MAY 25...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Royal Institution, Albemarle-street, W., 5 p.m. Prof. J. A. Fleming, "Electromagnetic Waves." (Lecture I.)
Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Messrs. W. Duddell and J. E. Taylor, "Wireless Telegraphy Measurements."

FRIDAY, MAY 26...Royal Institution, Albemarle-street, W., 9 p.m. Prof. J. W. Brühl, "The Development of Spectro-Chemistry."
Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.
Clinical, 20, Hanover-square, W., 8½ p.m. Annual Meeting.
Physical, National Physical Laboratory, Bushy-house, Teddington. 1. Dr. Harker, "The Specific Heat of Iron at High Temperatures." 2. Mr. Campbell, "The Measurement of Small Inductances." 3. Mr. Selby, "Two New Optical Benches."
National Service League (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Dr. Emil Reich, "The Importance of National Military Training from the Historical Standpoint."

SATURDAY, MAY 27...Royal Institution, Albemarle-street, W., 3 p.m. Mr. J. G. Frazer, "The Evolution of the Kingship in Early Society." (Lecture II.)

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FRIDAY, MAY 26, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

CANTOR LECTURES.

On Monday evening, 22nd inst., Mr. H. W. RAVENSHAW delivered the second and last lecture of his Course on "The Uses of Electricity in Mines."

A vote of thanks to the lecturer was passed unanimously on the motion of the Chairman (Professor Ayrton, F.R.S.).

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Owing to illness, SIR CHARLES METCALFE was unable to read his paper on "The Cape to Cairo Railway," on Tuesday, 23rd inst., and the meeting of the Section announced for that date was, therefore, unavoidably postponed.

CONVERSAZIONE.

The Society's Conversazione this year will take place at the Royal Botanic Gardens, Regent's-park, on Tuesday evening, July 4, from 9 to 12 p.m.

The programme of arrangements will be announced in future numbers of the *Journal*.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 24, 1905; JOHN GAVEY, C.B., Engineer-in-Chief and Electrician to the General Post Office, in the chair.

The following candidates were proposed for election as members of the Society:—

Evans, B. P., The Schools, Treharris R.S.O., Glamorgan.
Sanford, Miss S. Ellen, The Holme, Clifton Hampden, Abingdon.
Thoresby, Frederick, 1, Queen Victoria-street, E.C.

The following candidates were ballotted for and duly elected members of the Society:—

Bodie, Samuel Murphy, D.Sc., Macduff, N.B.
Drury, Henry George, M.V.O., St. Oswald's, Downs-road, Clapton, N.E.
Eldred, Byron E., 208, Fifth-avenue, New York City, U.S.A.
Garside, Alfred B., 1b, Dennington-park-mansions, West Hampstead, N.W.
Harvey, Frank E., British India Marine Service Club, Hastings-street, Calcutta, India.
Moore, Miss Esther M., 4, Bath-road, Bedford-park, Chiswick, W.
Noble, Mrs. G. J. W., 47, South-street, Park-lane, W.
Peattie, M. M. A., 35, High-street, Oxford.
Playter, Franklin, 6, Beacon-street, Boston, Massachusetts, U.S.A.
Short, Ernest Angelo, care of Messrs. H. S. King and Co., 9, Pall-mall, S.W.
Smith-Rewse, Colonel Henry Whistler, R.E., C.V.O., Brompton-barracks, Chatham.
West, Chas. A. W., P.O.A. Kafferstadt, Harrismith District, Orange River Colony, South Africa.
Whitehead, Ernest William, Twyneham, Queen's-road, Wimbledon.

The paper read was—

MODERN LIGHTNING CONDUCTORS.

By Killingworth Hedges, M.Inst.C.E.,
Hon. Secretary of the Lightning Research Committee.

The last time the question was brought before the Society of Arts was in 1888, when Sir Oliver Lodge made it the subject of his "Dr. Mann lectures."

I greatly appreciate the honour of being asked to follow such a distinguished predecessor, and to put before you this evening some of the more recent work in connection with this rather neglected branch of electrical science. The study of atmospheric electricity dates from very early times; it is doubtful whether the art of protection from lightning was known to the Egyptians,* but the Greeks and Romans are reported to have drawn fire from the sky, Tullus Hostilius is said to have perished in a sacred experiment of this kind; and Cicero, in his oration against Catiline, drew attention to the bad omen to Rome that was caused by the gilded figure of Romulus being destroyed by lightning. The well-known Capitoline Wolf still bears traces of the damage. It is generally supposed that Divisch, a learned priest, erected the first lightning conductor in Europe at Prendiz, Bohemia, in 1754; the rod was said to have been 130 feet high, and although he was patronised by the Emperor and Empress Francis Stephen and Maria Theresa, it had to be taken down a year later, as it was supposed to have occasioned a terrible drought. It is not likely that Franklin had heard of Divisch, and although it was due to a communication from Mr. Thomas Hopkinson, an American gentleman, in 1747, that his attention was turned to the matter, he is universally acclaimed as the inventor of the lightning rod which was made known in 1752, and which the European *savants* explained in accordance with scientific theories then current, as a conductor of a supposed "electric fluid" darting from the clouds to earth.

When the British Association met in Bath in September, 1888, Professor G. F. Fitzgerald, who was President of Section A, directed world-wide attention to the discoveries of Hertz, and hailed them as conclusive proof of the truth of Clerk Maxwell's theory of light. The next day Sir Oliver Lodge read a paper on "Measurement of Electro-Magnetic Wave Length," and the author stated that during his experiments on lightning conductors, which he mentioned in his lecture in March at the Society of Arts, as "The Experiment of the Recoil Kick," he hit on an arrangement of measuring the æther-wave lengths in a manner quite independent of that of Hertz, whose experiments were thus confirmed. At the same meeting a joint discussion of Sections A and G was held on lightning conductors.

If I remember rightly, Sir William (then Mr.) Preece opened the discussion by saying that it was a most remarkable thing that if one wanted to know much about atmospheric electricity one had to go back to the works of Benjamin Franklin, 140 years ago. Up to the year 1881 there was not even a code of rules in the United Kingdom to guide people in protecting their buildings from the destructive effects of atmospheric electricity. To the efforts of the British Association we owe the first set of rules, established by a conference of various societies which was formed in 1878 and brought forward their report, known as that of the "Lightning Rod Conference," at the York meeting in 1881.

The history of the art since then has been one of stagnation. Distinguished scientists like Sir Oliver Lodge here, and others in Germany, have put forward their views from time to time, but still we see conductors erected in a manner which can be shown both by laboratory experiments and by actual reference to lightning strokes to be a source of danger instead of acting as safeguards to the buildings; also the misleading belief of an area of protection in the case of the erection of an isolated rod, for instance, on a church tower, while the rest of the building has no conductor, and, what is more important, no metallic connection to earth.

Interest has been again revived, first in Germany by the Electrotechnische Verein, of Berlin, which after much discussion published on July 21, 1901, a set of rules and recommendations for the protection of buildings; and in this country we have the Lightning Research Committee, organised early in the same year jointly by the Royal Institute of British Architects and the Surveyors' Institution, and with the approval of the Royal Society and the Meteorological Society. Members of all these institutions were represented on the committee.

A notice setting forth the existence and requirements of the Committee was issued to the Press, and appeared in all the technical journals interested, and in more than a

* Brugsch suggests that the grooves on pylon towers were used for masts designed to protect Egyptian temples.

hundred representative newspapers in London and the provinces.

An immediate response to the Committee's appeal for observers was received from 225 persons, distributed throughout the United Kingdom as follows:—

Buckinghamshire	3	Lincolnshire	3
Berkshire	2	Middlesex	9
Cambridgeshire	3	Northamptonshire	3
Cornwall	7	Northumberland	4
Cheshire	10	Norfolk	4
Derbyshire	2	Nottinghamshire	1
Durham	6	Rutland	1
Devon	7	Sussex	11
Dorsetshire	2	Surrey	11
Essex	6	Suffolk	5
Gloucestershire	7	Scotland	12
Hertfordshire	1	Staffordshire	6
Hampshire	4	Somersetshire	4
Herefordshire	2	Shropshire	2
Isle of Wight	2	Wales	14
Ireland	5	Warwickshire	5
Kent	15	Worcestershire	2
London	22	Westmoreland	1
Lancashire	12	Yorkshire	14

By the kind assistance of the Secretary of the Institution of Electrical Engineers copies of the Committee's memorandum and schedule of questions were sent to some 400 members of that institution residing in the Colonies, in India and in foreign countries. As a result some interesting records were received, also from the United States.

Through the influence of Mr. J. Gavey, engineer-in-chief to the General Post Office, the various district engineers of the Post Office were enlisted as observers. The Committee desire to acknowledge their special indebtedness to these gentlemen for a number of admirably recorded occurrences, which have been found of much value in their investigations.

The War Office, the Home Office, the Trinity House Corporation, and the United States Department of Agriculture, have also furnished the Committee with particulars of damage caused by lightning to buildings under their control.

The services of a press-cutting agency were engaged to supply the Committee with current newspaper notices of buildings that had suffered from lightning-stroke in thunderstorms. Between four and five hundred such notices reached the Committee during the years 1901-4; and in neighbourhoods not represented by the official observers application was immediately made for particulars to the owners or occupiers of the property affected, or to members of the Royal Institute of British Architects or of the Surveyors' Institution residing in their vicinity.

"It was decided after the first year to confine the Committee's investigation to buildings which were fitted with conductors, and, following this course, the reports on about 40 protected buildings affected by lightning have been summarised by a sub-committee, and the report of the general Committee states that as far as they are able to judge from the newspaper reports which have reached them, the number of reported cases of buildings damaged by lightning in Great Britain during the three years 1901-4 amounted to over five hundred. Altogether the Committee have had before them detailed reports from their observers of the damage done in 115 cases. Seventy-five cases related to buildings which were without any form of protection. The remaining 40 were provided with what had been considered by those responsible for the buildings as sufficient safeguards in the way of lightning rods. While taking due account of the lessons to be learnt from the action of lightning on unprotected buildings which have been injured, the Committee have deemed it unnecessary for the purposes of this report to go into the details of these cases. A selection, however, has been made from the reports of 'protected' cases, and these will be found summarised and put into tabular form in Appendix A, with observations in some instances of the conditions which appear to the Committee to have contributed to the failure of the means of protection provided."*

It has been pointed out by Sir Oliver Lodge that lightning discharges are of two distinct characters, which he has named the A and the B flashes respectively. The A flash is of the simple type which arises when an electrically charged cloud approaches the surface of the earth without an intermediate cloud intervening, and under these conditions the ordinary type of lightning conductor acts in two ways; first, by silent discharge; and secondly, by absorbing the energy of a disruptive discharge. In the second type, B, where another cloud intervenes between the cloud carrying the primary charge and the earth, the two

* Selections of the illustrations forwarded by the Committee's observers on protected and unprotected buildings have been reproduced by the author in a book entitled, "Modern Lightning Conductors." London: Crosby, Lockwood, and Son.

clouds practically form a condenser; and when a discharge takes place from the first into the second, the free charge on the earth side of the lower cloud is suddenly relieved, and the disruptive discharge from the latter to the earth takes such an erratic course that no series of lightning conductors of the hitherto recognised type suffice to protect the building.

On the 28th May last a demonstration of the action of A and B flashes respectively was given by Sir Oliver Lodge before members of the committee and others interested in these researches. A thin sheet of metal mounted on non-conducting standards represented the cloud, which was charged at will from a Leyden jar. The "cloud" was so arranged that the model lightning conductors could have their points brought nearer to or further from its under-surface by shifting their positions on the table. Conductors of copper, iron, and wet string were experimented with. The disruptive discharge to the copper proved to be by far the loudest and most intense of the three. The iron took the flash with less noise, the wet string with hardly any; yet when the discharge passed through it the other and apparently better conductors were not affected. The experiments tended to demonstrate that iron is in many situations a very useful material for lightning rods, as the effective energy of a flash of lightning is rapidly dissipated in iron. This metal, however, unfortunately, oxidises rapidly in towns and smoky districts, and the use of copper is still recommended for main conductors in relatively inaccessible positions as a material for lightning rods.

In Germany two kinds of strokes have been recognised for some time, one as Zündenden ("fire causing"), probably analogous to what Sir Oliver Lodge terms the B stroke, while the other, known under the name of Kalten ("not causing fire"), is the ordinary A flash.

The Committee remark that it is probable that, with few exceptions, buildings in this country are not in reality efficiently protected against the effects of a B flash, although in many cases the lightning conductors may be said to have at least partially fulfilled their purpose by carrying off the more violent portion of a discharge, and without them greater damage would have occurred in many of the cases reported.

Some of these observations throw a very interesting light on the effects due to the oscillatory character of lightning discharges. For instance, a discharge takes place over a lightning rod which may be in contact with, or approach closely to, the metallic portions of a roof. Powerful electrical oscillations are set up in the latter conductors, and dangerously high electrical pressure may be generated on the distant ends of these conductors. If at these points they were connected to earth the pressure would be relieved and the discharge harmlessly dissipated. Without this safe path the discharge may break away into the down pipes, or may pierce the roof to reach internal conductors. Cases which appear to indicate successive or simultaneous flashes may be due to a single flash setting up these oscillations.

In some cases the damage done to a building by an A flash is not necessarily due to the primary discharge. A lateral discharge occasionally occurs, which frequently causes minor, though in some cases serious, damage, owing to falling materials.

Many of the reports of damage to unprotected buildings show that the lightning discharge followed the path of wire ropes, metallic pipes, and other conductors, and that the damage to the structure occurred at the breaks in continuity at the upper and lower terminals respectively.

It may be considered that a lightning conductor of the ordinary type, if properly constructed, affords an undefined area of protection against A flashes; but it cannot be said to have any protective area against B flashes.

Absolute protection of the whole of a building could only be assured by enclosing the whole structure in a system of wirework—a contrivance, in fact, of the nature of a bird-cage. This should be well connected at various points to earth, as nearly all buildings have gas and water pipes and other metallic conductors in their interiors which are likewise earthed. For structures intended for the manufacture or storage of gunpowder and other explosives, the adoption of this bird-cage protection would be justified on the score alone of public safety. Architectural considerations prevent the adoption of such a method in its entirety for ordinary buildings. There is no doubt, however, that practically perfect protection may be assured by a judicious modification of the existing practice of erecting single lightning rods, especially in the case of extensive and lofty buildings that project well above surrounding structures, or that stand isolated in the open country.

There is another name I wish to mention, and that is Colonel the Hon. Arthur Parnell, who read a paper in 1884, before the Royal Institute of British Architects, on the action

of lightning strokes in regard to metals and chimneys of buildings.

I especially draw attention to this paper, as the author was the first to point out the many disasters which occurred to buildings fitted with lightning rods, and that a single metal rod run up the most prominent portion of a building offers a very small protection to the whole structure. He also stated, "That the damage was usually due to mechanical force and not to heat." I quote the following extract :—

"Many persons would doubtless imagine that dry wood-work was more likely to be charred or burnt than to be forcibly rent by a flash of lightning, without a mark of scorching, but the reverse is the case, also in respect to metals, few would believe that this agency was more apt to break or bend metals than to fuse them."

Another point was that in 34 per cent. of the incidents investigated the mechanical force was shown to have been exerted in a more or less upward direction.

The paper referred to was read in what might be termed the dark ages, when fixed opinions were generally held as to what I might term the A. B. C. D. behaviour of lightning—that is, let A represent a building, B the chimney or highest point on the building A, and C the air terminal of the lightning conductor somewhere up above B; we were told that any lightning in the neighbourhood would be attracted to C, and pass through the rod, D, harmlessly to the ground; also it was thought that, besides attracting the flash, the conductor, D, shielded all parts of the building, A, which came into the area of a cone whose base was assumed to have a radius equal to the heighth from the ground. This was stated in the report of the Lightning Rod Conference, page 13, 1882; but it is only fair to say that the Committee, although deeming it sufficiently correct for practical purposes, say "that it cannot always be relied upon."

I am sorry to have to remark that Colonel Parnell's paper did not meet with the attention it deserved, and the general opinion evinced in the discussion was, that it was chimerical. Those who have studied the subject, and who have read the works of Sir Oliver Lodge in this country, and the report of the Berlin Electro-Technical Association published in 1901, take a very different view to the assumptions put forward by the Lightning Rod Conference, and do not agree that lightning is attracted by the conductor, and also consider that the protected area theory first promulgated by the Paris Academy of Sciences in 1823, under the name of the Cone of Charles, and introduced in an amended form by Gay Lussac, is not supported in actual theory, in fact the report of the Lightning Research Committee contains many examples which show that there is no area of protection, and this opinion is put forward by the experts of Germany, Hungary, and Holland, whose reports will be found in the supplement to that of the Lightning Research Committee.

There is a story told of Sir William Thomson (now the distinguished Lord Kelvin), who, after addressing some merchants in Scotland, heard a well-known mill owner remark that it was wrong to oppose the ways of Providence, and much cheaper to insure, and there may be some in this room who hold a similar opinion. I must therefore trespass on their kindness, and ask them to bear with me for a short time, while I go into the important question of: first, as to what we have to guard against; and secondly, as to the best method of protection.

Let us first go back to Benjamin Franklin. Did he understand the action of lightning? I am of opinion that if he had been allowed to have had a free hand when he introduced the lightning rod (which, by-the-bye, originally met with much opposition, especially from the church) the early installations which bore his name would have been put up in a very similar manner to that which the report of the Lightning Research Committee will suggest to be the future standard.

I have here one of the Franklin rods, known at the time as the Jesuit rod.

I believe this is part of, at least, one of the very first lightning conductors erected in this country, as it came from the inside of the dome of St. Paul's Cathedral—I removed it myself in the year 1900—where I think it was placed in 1756. There were three of these iron bars connected to the metal cross—the reason for these joints was to allow the conductor to be shaped to the inside of the upper dome; so far it was run in a fairly good manner, but unfortunately, the ends of these bars passed through the stonework, and then were doubtless continued to the several galleries and finally to the earth; but some time or other these outside rods were removed. Consequently, I discovered that the original protection became a source of danger in that the rods stopped short in the stonework, and had no earth connections. That was no part of Franklin's scheme, who doubtless, had well

thought out the matter, and in using iron conductors he was putting forward the most suitable material, a fact suggested by Hertz, and practically demonstrated by Sir Oliver Lodge.

Most people travel on the continent, but I venture to think very few have noticed that, I might say without exception, the lightning conductors used so freely on the cathedrals and public buildings abroad, are always constructed of iron. There are two reasons for this: one is, that they have never changed from Franklin's original iron rod, and the other is, that practical experience shows that this material is superior to copper. Architects here discarded iron because of the so-called unsightliness of having bars or rods running down places where they were of necessity visible, and rather welcomed the innovation of the copper band or cable, which by degrees has been diverted by the contractors for its erection—I cannot style them electricians—until at the present time, this copper band is run round sharp angles and tucked away into obscure corners, where it is unseen, and also to a large extent, quite useless for the purpose for which it has been erected. Fortunately, you cannot do this with a rod of iron three-quarters of an inch or more in diameter, so the lightning conductors abroad are run as they should be, straight up and down from the spire or roofs to the ground, and they have proved their efficacy. As far back as 1888, Sir Oliver Lodge showed that the old view of lightning protection was as if there was something to be allowed to escape or let down like rain, or as if there was a certain amount of stuff called electrical discharge to be got rid of, and all you had to do was to provide a channel down which it would go, avoiding all other channels, so that it would neglect all other paths and take the easiest one to earth. It was also supposed that the easiest way to get rid of the electricity one did not want was to supply it with the best possible conductor, in fact, the largest one could afford, and the only reason for not using a copper rod a foot thick was that of expense. But it is now known that a copper rod of this area would be dangerous, and a number of iron wires, one-tenth of an inch in diameter, would be much safer. Why is this? Is it that copper, which is one of the best conductors of electricity, is not so suitable for the purpose of protection as iron? The answer is, because of electrical inertia. A copper rod allows the discharge to pass too quickly, and produces a shock of the utmost violence; in fact, experiments were recently shown at the Royal Institute of British Architects where a large copper conductor, which was perfectly earthed, gave out sparks of great intensity, and these, if a lightning discharge was passing, would be quite sufficient to set fire to the building. An iron conductor offers more impedance to the current, and allows it to leak away by damping down the oscillations, so there is less chance of a side flash from an iron than from a copper conductor.

The characteristics of a flash of lightinng which more particularly concern us are:—(1) surging, that is due to the oscillatory character of the spark, which, unlike the currents employed for conveying electricity to a distance for lighting cities or driving tramcars, is a disruptive discharge, sudden and violent, more like the blow of a hammer; (2) self-induction, a property which gives rise to counter force or choking effect, noticeable in straight wires, but which is much more pronounced in coils of wire; (3) side flash, the result of self-induction. A disruptive discharge will often leave what would ordinarily be called an excellent conductor and side flash through the air to other much worse conductors; for instance, the lightning rod may be struck, but instead of following the course provided, a side flash may select its own path through a wall of brick or stone to a neigbouring gas-pipe or bell-wire. The often-quoted example of this danger is the accident at All Saints' Church, Nottingham, about 1870, when the discharge passed from the lightning conductor through a solid wall of masonry, 4½ feet thick, to a gas-pipe. A photograph appeared in one of the magazines a short time ago showing about twenty oxen lying dead along the line of an iron-wire fence, thus practically illustrating the surging effect of a lightning flash which may cause great damage. That these cattle were killed by a side flash from the line of the fence may be inferred from an incident mentioned at the discussion on lightning conductors before the British Association in 1888. A number of horses placed in a row were struck, the first and last of the row being killed and the others not touched by a lightning discharge.

Unquestionably, wire fences as now constructed serve as death-traps to cattle in many countries. The Director of the Iowa, U.S.A., Weather Service, in September, 1898, says:—"These reports show that of the 256 head of live-stock killed by lightning, 118

were found in close contact with wire fences, and also that, as there were no ground wires to the fences, over 44 per cent. of the losses were caused by contact with the wire charged by a lightning stroke, which struck the fence at a considerable distance from the point where the stock was killed."

A later report mentions that a number of deaths have occurred to persons who have been, during a thunderstorm, placing or removing clothes from the wire which takes the place of the clothes-line in the Western States.

I now purpose to show some slides taken from photographs, and plans of buildings which have been submitted to the Lightning Research Committee by their observers; all these buildings have been fitted with lightning conductors, but unfortunately owing to the way they have been arranged they have not altogether shielded the buildings from damage.

The principal causes of the failure of the usual style of lightning-rod as fitted on the buildings investigated, appear to be due to the following: (1) insufficient number of conductor and earth connections; (2) the absence of any system of connecting the metallic portions of the buildings to the lightning conductor, especially the interconnection of the finials, rain-water pipes, and gutters. In the author's opinion the frequent damage by side-flash from the conductors might be lessened by running a horizontal conductor along the ridge, or along the parapets of all the roofs, somewhat after the method which is almost universally adopted in Central Europe.

The lightning strokes may be divided into three classes:—(1) Those where the conductor conveyed a portion of the flash to earth, but the side flash to other unearthed metallic conductors damaged the building; the practice of running the conductor round the projecting masonry, often taking sharp bends, doubtless facilitated the deviation of the current from its direct path to the earth; (2) in several observations a metallic roof of large area received the flash, consequently became highly charged, and the single conductor failed to convey the whole of the stroke, a portion of which took a circuitous path, for instance, through a speaking tube and an electric bell wire; (3) a flash struck the building at two points simultaneously, a lightning conductor taking one part of the stroke, but damage was caused by the other portion selecting an unprotected part of the roof.

Truro (Kea Church).—Wooden spire (88 feet high) covered with copper. Reported by Messrs. J. C. Daubuz and G. H. Fellowes Prynne. Tiling damaged; lead flashings turned back; wall considerably shaken and the face stones fractured. Divided; part going by conductor and part by alternative path formed by copper covering of spire, iron pipe, &c., from which it sparked through parapet wall to lead flashing. Copper tape 1¼ in. by ⅛ in. Good earth. Copper sheathing of spire, rain-water pipe, and copper wire which passed over conductor and near pipe. The rain-water down pipes should have been connected with the roof metals, *i.e.*, to the copper roof and lead flashings, and also to earth. This would have prevented the side flash and consequent damage.

Hampstead, Golders-green.—Convalescent Home, formerly private residence. Reported by Mr. Walter Hall. Small hole made in apex of gable, casement of window damaged; plastering damaged and looking-glass smashed. Copper rope ½ in. and ⅜ in. diameter, and rod ¾ in. Three points. Only one finial point protected; three without conductors. All the finials should have been connected by subsidiary conductors to earth.

Stoerhead Lighthouse.—Metal roof and iron railing around lighthouse. Reported by Mr. J. M. Irvine, Engineer. Wall damaged; bedstead scorched; gutta-percha wires of telephone circuit burned; woodwork set fire to. Part at least took path by speaking tube, telephone wires, and also by bedstead to wires; thence to earth at pole. Copper rod ¾ in. or ⅞ in. diameter. Earth not good. Resistance from ground line 29 ohms. Iron railings; speaking-tube and telephone wires. An isolated building on an eminence. The copper speaking-tube and the iron railing around the lighthouse should have been connected to independent earths.

Rochdale (Stricklands Brewery).—Stone building, tall chimney, iron band round base of chimney. Reported by Mr. H. Frost, Sectional Engineer, P. O. Telegraphs. Chimney cracked 15 feet above shed abutting on stack; portion of rod above chimney broken off. Rod with three prongs. Character of earth unknown. No sufficient data could be obtained to admit of a definite opinion as to cause of damage.

Cambridge (Cavendish Laboratory).—Reported by Mr. W. M. Fawcett, M.A., F.S.A. Displaced tiles; made hole through sill of dormer and fused gas pipe. Struck brass nob on top of lead-covered angle of roof, passed to lead cheek of dormer and to gas pipe. Copper wire rope ⅜ in. diameter on tower. Conductor on tower 36 ft. from point struck. Not stated, but the rod had been recently fixed. Passed by brass nob to iron rod and lead cheek of dormer and gas pipe.

Illustrates the need for earthing all metallic portions on the roof of a building.

Cubbington (Warwickshire).—Workmen's dwellings, school-house, and residence. The lightning spread over the roofs of these low buildings, earthing by the rain-water pipes. The interesting feature of this case is the effect of one portion of the flash, which perforated the brick wall, 1½ ft. thick, of the schoolmistress's house, where the pipe-hook supported the gutter. It made a hole about ½ in. wide, then jumped to a wall on which a small gilt frame was hanging, playing over the gilding, which appeared as if washed off; it then again pierced the wall near the bottom of the frame and escaped by the pipes. The slide is taken from a photograph of the wall-paper.

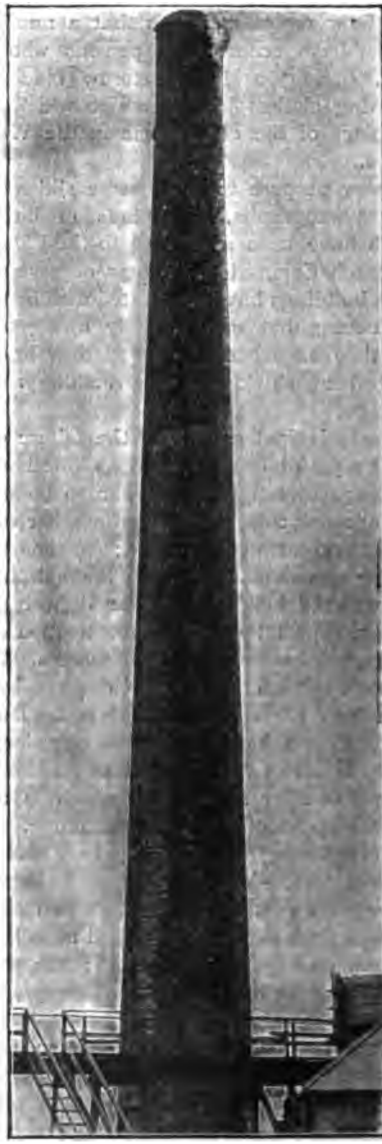
Mark's Tey (St. Andrew's Church) —Tower of oak; wooden spire covered with oak shingles. Reported by Mr. W. Cressall. Displaced weathercock and disturbed some bricks. Probably struck weathercock, and passed to conductor connected therewith. Copper wire rope, ½ in. diameter; single pointed terminal. Beyond displacing weathercock at top, and a few bricks where the rod entered the ground, no damage done; although apparently not efficiently terminated at either end, the rod conveyed the charge safely to earth.

Highgate (St. Michael's Church).—Tower and spire surmounted by stone cross, 145 feet high. Reported by Mr. Walter Hall and Mr. Killingworth Hedges. One arm of stone finial cross broken and displaced; ball of cross shattered; falling stones crashed through roof of nave. Struck arm of cross, then probably passed to conductor. Copper rod, ⅝ in. diameter. Earth. Found to be in connection with the electric light mains A stroke caused similar damage some years ago.

Bedford (St. Paul's Church).—Tower and spire. Reported by Mr. W. P. Goulding, F.S I. Heavy beams inside building slightly displaced, supporting corbels split; main switch of electric light fused. Iron rain-water pipes broken; lead flashings on roof broken and torn away. By conductor from top of spire to lead flat, at bottom of spire, on which conductor lay; then divided, portion finding earth through rain-water pipes, &c. Copper cable ⅝ in. diameter terminated under seat of weathercock at bottom, if spire is laid on the lead flat. Path. Formed by lead roof and rain pipes, &c. A very interesting case. The conductor being in contact with the lead flat violent oscillations were set up, which extended the whole length of the roof; no subsidiary conductors being provided, the discharges took all available paths, some inside and some outside the building.

Walsall (Shire Oak Brewery).—Chimney 70 feet high. Reported by Mr. G. H. Boulter. Bricks displaced at top of chimney, and earth dislodged at bottom of conductor. Struck chimney opposite conductor, and then passed to conductor. Copper tape and rod carried 4 ft. above chimney. Building occupying the highest ground in the neighbourhood. Illustrates fact that lightning conductors on a shaft should terminate at the upper extremity in manner recommended by Committee. (Fig. 1.)

FIG. 1.



THE PATH OF A FLASH DOWN A CHIMNEY WITHOUT A CONDUCTOR, SHOWING DAMAGE.

Maidenhead (Church [of all Saints).—Reported by Arthur Goulding, F.S.I. Cock on finial of tower knocked off the spindle, breaking some tiles in its fall. Finial rod and cock to copper conductor. Finial rod ¾ in. iron 6 ft. above apex of spire; ½ in. wire rope. The cock formed an imperfect upper terminal to the lightning rod; apart from this the rod acted efficiently. (Fig. 2).

FIG. 2.

ALL SAINTS' CHURCH, MAIDENHEAD.

Coatbridge, Lanarkshire (Church).—Tower about 80 feet high, upper half octagonal, carrying eight cone-shaped balusters, one at junction of each angle. Reported by Mr. W. E. A. Knight. Three balusters damaged and part of conductor rod led round tower fused. Roof damaged by falling stones. Struck balusters, then followed circular part of conductor to loop, then to vertical conductor and to earth. Copper rope of seven strands from above balusters to earth. A subsidiary conductor carried around at the base of the balusters and connected to main rod. A conductor on each baluster reaching down to the circular band at the base of the balusters would have prevented all damage.

Isle of Wight (Godshill Church).—The lightning missing the flag-staff, struck the pinnacles and parapet, passing between the latter and the lead flat forming the tower roof, which was uninjured, acted as an explosive inside the tower, destroying the stairs, clock casing, deal panelling (filling in the tower and next to the nave), broke all the windows, dislodged the basin of the font from its pedestal, doing minor injuries inside the building. The walls of the tower three feet thick were forced open at the quoins, and the clock fell (blown some fifty yards from the tower). Reported by Mr. Arthur Goulding, F.S.I. The case is interesting for two distinct reasons. First, that the high flag-staff with metal vane, which certainly was a more salient feature and a better conductor than a stone pinnacle, was untouched; and secondly, although the church had been previously struck in 1778 and in 1897, the insurance companies have not insisted on any system of protection.

Tunbridge Wells (Southborough Vicarage).—Reported by C. H. Strange. Detached building standing on a hill about 400 feet above sea level. The mechanical effect of the discharge was very great; the chimney struck is indicated by dotted lines on the slide. It then blew out the face of the chimney breast on the bedroom below, and finally wrecked the fireplace on the dining-room below. During the same storm a number of the incandescent lamps (unlighted) had their filaments broken.

Possingworth House, Cross-in-Hand (Private dwelling).—Reported by Mr. Killingworth Hedges, M.Inst.C.E. Building struck twice. First case struck and displaced conductor, and also did damage to chimney and stacks. Second case destroyed chimney, damaged roof, and part of the divided flash struck statue not provided with rod. First case main charge probably followed rod. Second case the flash ignored the intermediate chimneys, which were all protected by individual rods, and struck the one unprotected point, which was much lower than the chimney-stacks. Copper tape, 1½ in. Every chimney-stack fitted with a rod. The flash struck the rods on both occasions about three feet below the air terminal. Good earth. The tape conductor was run indirectly to earth, so that a portion of the charge travelled down the wet roof. These two cases can only be reasonably explained on the supposition that the discharges were of the B type, and this hypothesis is supported by the fact that numerous trees in the neighbourhood were struck; an unusual number of lightning rods were provided, although they were not interconnected. It will be noted that the structure did not suffer any internal damage, so that the rods afforded some measure of protection; and if they had been connected by a horizontal conductor, furnished with more direct earth connection, the damage might possibly not have occurred. (Fig. 3.)

FIG. 3.

DIVIDED FLASH, POSSINGWORTH HOUSE, SUSSEX.

FIG. 4.

AINSWORTH MILL, BOLTON.

Bolton (Ainsworth Mill).—Chimney about 60 feet high. Reported by Mr. W. W. Midgley, F.R.Met.Soc. Chimney demolished. Windows of mill broken; gas-pipe fused and gas ignited. The fall of the chimney wrecked the engine-house, and the mass of *débris* was so great as to prevent further investigation. The flash would appear to have taken a path along the interior of the chimney in preference to that furnished by a faulty lightning rod, for it burst out with destructive violence at the base of the chimney, causing the collapse of the whole.

Modern Lightning Conductors.

To carry out the recommendations of Sir Oliver Lodge, who, in his paper read before the Institution of Electrical Engineers in 1889, stated that "sharp bends and roundabout paths to earth should be avoided, and that a lightning conductor detached from a building is safer than one in close contact to it," the author has designed special clamps or holdfasts which project from the wall or position where the conductors are run, and hold them away from the same, and facilitate the cable being strained so as to avoid the projecting masonry. The conductor is then firmly held by a special grip at the end of the clamp, which only requires one screw. The joints used in the system, in order to secure perfect conductivity, are made by pouring solder or pot-metal over the loosely-spliced, previously tinned, conductors, which are laid in a box, that can be used either for two, three, or fourway joints. Similarly, if it is required to connect the cable to a plain point, it is either inserted in a socket or in a box which is fitted with a socket to receive it, and molten solder completes the electrical connection.

Elevation rods are made in a similar way. Here are shown three forms, for either tape or rope. The multiple points are not screwed in, as the threads deteriorate with age, and they are liable to drop. Therefore they are secured to the centre point by means of the sleeve, which has recesses in which the points are secured, and the box is filled with solder. If required to be packed, the points are kept closed together, and afterwards bent to shape. The Continental practice of running a horizontal conductor along the ridges of all the roofs has been adopted by the author in all the important installations he has specified, with the double object of interconnecting the different elevation rods, which are fixed on the higher points, such as the chimney stacks, and also to offer a good path for the lightning, should, as is often the case, side flash take place. From this conductor smaller wires are taken to the rain water guttering, which in its turn is connected to the rain water pipes, and thence to earth. At Westminster Abbey, and on other buildings where the roofs are very long, aigrettes are fixed to the ridges at intervals, the conductors passing through them as shown. Fig. 5 illustrates how a roof, say, of a large church is fitted, the aigrettes themselves, as well as the down conductors, being in contact with the lead of the roofs. Thus it will be seen that the object in view has been, as far as possible, to surround the building with a protective network. The ideal plan advocated by Sir Oliver Lodge would be to encase it with barbed wire. Doubtless this would be very effective, but hardly practicable, on account of repairs to the structure. The author has endeavoured to retain the effective network without sacrificing its utility, and although there are many points for the discharge of the electricity which gathers on the surface of a building during a storm, these are so unobtrusive as to be hardly noticeable by a spectator below.

The above is a description of existing practice, but it is quite possible to shield a building in a very different manner by the use of iron wire; a suitable size is seven strands known as a seven ply galvanised cable about $\frac{3}{8}$th inch diameter. Here is some of the material, and as it is very cheap, one may use a lot of it and more nearly approach the ideal "bird cage" advocated by Clerk Maxwell. If economy is an object, air terminals or elevation rods need not be used, the vertical iron conductor is carried up so as to project above the various chimney stacks and pinnacles or points, and can be opened out so as to present a number of points. The general appearance of a building protected in this manner is shown by the slide which represents a pumping station and chimney shaft. In actual practice the wires which form the cage over the building will hardly be noticed from the ground level. The number of barbs shown in the slide can be modified, in fact where there are many finials or if there is iron cresting, it would only be necessary to have a few points on a horizontal wire which runs along the ridge, and this can be either armoured by twisting round it short pieces of steel wire as shown; the lower legs will keep the conductor away from the roof. A more durable way of holding the conductors is by means of a special device which the author has designed for use in almost every position where stranded wire is employed. You see that it is a triangular, malleable casting, furnished with a spike when used horizontally, the lower legs can be turned over to grip the ridge of the roof or be fastened to the lead flat, and for vertical conductors the same casting does without the spike. A simple and efficient method of joining the cable to the casting is accomplished by a specially designed lead ferrule, which is inserted and closed up

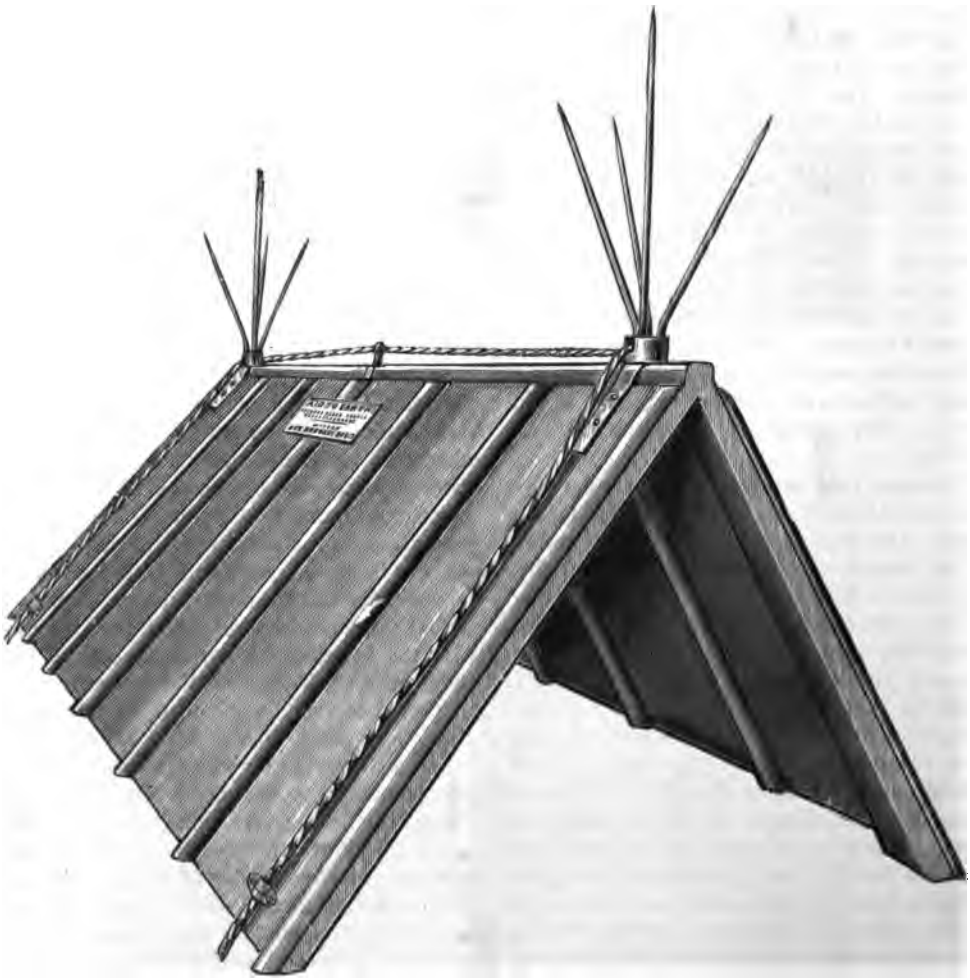
by a tool; it can also easily be removed if the system has to be disconnected.

In all cases where rain-water pipes are used as conductors, care must be taken to bond the joints, so as to ensure good electrical connection, that is if one does not care to risk the cracking of the sockets which form the path of the discharge. There are many ways

CONTINENTAL SYSTEM.

With the exception of Belgium, where the Melsen system of having a network of copper conductors over the buildings connected at the roof to a number of copper rods made up in bundles of eight, and spread out like a feather, is often employed, iron is the material in general use.

FIG. 5.



MODEL OF ROOF OF WESTMINSTER ABBEY, SHOWING AIGRETTES ON RIDGE.

of bonding, here is one which is simple, and can be fitted after the pipes are erected.

Fig. 6 shows the method adopted by the author for the new Royal Horticultural building, Vincent-square, S.W., and Fig. 7, the arrangement of conductors on a private house at Brighton.

In France the standard rod or *tige* is six mètres high, the diameter at the base about 0·060 mètre, tapering to a sharp point; this rod is firmly connected with the iron work of the roof and the iron down conductor is fixed at the base, usually the tige is connected to the horizontal rod which runs along the ridge

FIG. 6.

ROYAL HORTICULTURAL BUILDING: MODIFIED CAGE PROTECTION.

FIG. 7.

MODIFIED CAGE, PROTECTION OF HOUSE.

or round the eaves, being kept away about 18 inches from the roof. The down conductor is sometimes of stranded iron cable, but more often a solid rod three-quarters of an inch to one inch in diameter, bolted together at the joints.

The earth connection is often made by leading the rod into a well. In one form in use in France, surface is obtained by plaiting up galvanised iron strips so as to form a basket which contains a sort of grapnel attached to the conductor, the basket being filled with coke.

The various fittings are shown. The next view is one from a photograph (Fig. 8), and shows the way the conductors are run to protect the Vatican, Rome. The next is from a photograph of the roofs of a hospital at Naples. The two wings are connected by the cable which runs across the intervening space. Thunderstorms are very severe in parts of Germany—the loss annually amounts to £200,000 —consequently the system of protection is much more elaborate than the practice here. In the neighbourhood of Frankfort, I noticed the roof of a factory with twelve projecting air terminals, each not less than twelve feet in height.

The German rules of the Electrotechnische Verein may be summarised as follows:—

"Special attention is drawn to the fact that the conductors of the buildings must be in metallic connection with the earth, and that they ought to go round the building, especially round the top of the roof, and, if possible, on all sides of the roof, and then lead to the ground in the shortest possible way, avoiding all sharp curves. Metallic parts in the building and masses of metal, especially those in contact with the earth and offering large surfaces, are to be connected together as much as possible and to the conductors. In order to decrease the cost, consideration should be given to utilising the pipes upon the building, and all metallic parts should be made use of where possible. Conductors of iron are generally used, and should have a sectional area of not less than 50 square millimètres if interconnected, and not less than 100 square millimètres if unconnected. If the conductors are of copper, half these sections is sufficient. All connections to have a metallic contact surface of not less than 10 square centimètres. Conductors must be repeatedly tested."

Many local boards in Prussia insist upon lightning conductors being fitted on public buildings, such as schools, town halls, hospitals, and churches. The regulations vary with the different local authorities. In Frankfort the municipality have the following:—

"The erection, alteration, and repairs of lightning conductors must be in accordance with the scientific rules now in force. The conductors must be of pure copper, and of not more than seven strands. House owners must have their lightning conductors examined at least every two years, and an examination is also required in the case of the erection of, or alterations or repairs to, a lightning conductor which has been struck. Designs and specifications of proposed erections must be submitted to the local board, and for the accuracy of the same the house owner is responsible."

How to Protect a Building.

Before going into the question of what accessories in the shape of lightning conductors are to be erected, it is necessary to study the disposition of all the external metal work—the material of the roof, the finials, and all ordinary guttering, flushings, rain-water pipes and connections, drain ventilators, telephone, electric and bell wires; having made a rough plan of these, arrange that the conductors are run from the highest points to earth, but in the case of a church, where the vertical conductors arrive at the main roofs, a horizontal conductor must be placed, so that besides being in connection with those from the tower, it runs along the ridges of the roofs, whence it is connected to all salient iron work. From it descend other conductors, which are connected to all the guttering and rain-water pipes; in many cases these can be used as down paths to earth, but it is well in the case of a building of considerable area also to run the branch conductors direct from the roof to the earth.

As regards air terminals, it is not absolutely necessary to let these project much above the highest points; if there are many chimneys or spires, each should have a pointed rod, and for a church or other long roof, aigrettes fitted to the horizontal conductors which run along the ridge are advisable in order to discharge the electricity which will accumulate during a storm all over the building and be collected at many points on the roofs.

Earths.—No rule can be given as to the number required, it greatly depends on the nature of the soil; for instance, a church on the top of a hill on hard limestone would require a great many more earth connections than one in a valley. An earth to be of use must be of low resistance, that is only obtained permanently in moist ground, and if this is not easily obtainable the best way to keep the earth connection damp is to run a small pipe from the nearest rain-water pipe in such a manner that some of the rainfall is diverted

directly to the metal plate which forms the earth.

This portion of the lightning rod has hitherto received the least attention mainly because architects and others have drawn their specifications so loosely. Here is an extract from one recently sent me which referred to some large schools:—"The conductor to be connected at base to a copper earth-plate 3′ 0″ × 3′ 0″ and 1/16 thick, buried 6′ 0″ deep in earth at a distance of not less than 8 yards from the wall at base."

Nothing is said as to where the earth-plate is to be buried, or whether the soil is rock or chalk, the consequence is that one finds earth-plates almost insulated from the ground in dry weather and quite ineffective. The connection between the copper plate and the lightning conductor is also often faulty; the latter often gets rough usage and consequently becomes disconnected from the plate. When asked to test an "earth," I generally pull the conductor, as in several cases I have found it disconnected entirely.

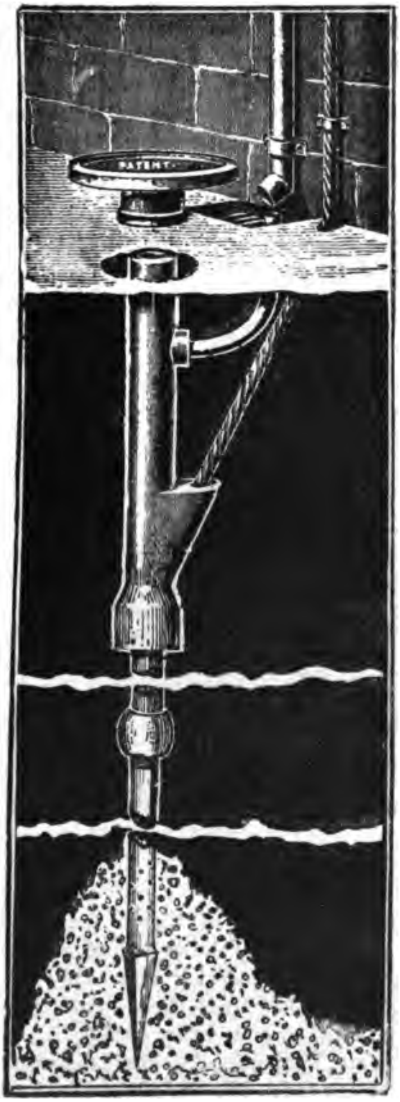
At St. Paul's Cathedral the conductors had been originally laid in a brick sewer which passed round the building, this became unused and was consequently left dry; when I discovered them some were placed inside and others were outside the drain pipes which took the place of the sewer, and were quite insulated and consequently useless. The example is not quite so bad as the one in a northern city where the conductor was insulated in a ginger-beer bottle, which had been duly buried to act as an earth. The cathedral is surrounded by the foundations of the previous structure, which rendered it difficult to make a deep enough hole for a plate earth; this led to the design of the tubular earth, which has now been largely used. This is made in two sizes, and consists of a strong perforated steel pipe, either 1¼ in. or 2 in. diameter, and furnished with a sharp spike, which will cut its way through chalk or gravel. At St. Paul's Cathedral it was easily driven through the broken stone which marks the site of the previous structure, destroyed by lightning long before Benjamin Franklin's discovery of the lightning rod. The end of the tube having been protected by a thick driving-piece, which is screwed on temporarily, it is easily sunk by means of a hammer or mallet, and if there is an obstruction, the pipe is moved by a bar inserted in the holes of the driving-piece. Lengths, connected by a special form of socket, are added until moist ground is reached. The conductor is threaded through the cast-iron top piece, and dropped to the bottom of the tube, which is filled with finely-

FIG. 8.

THE SYSTEM OF LIGHTNING CONDUCTORS ON THE VATICAN, ROME.

granulated charcoal. An electrical joint between the conductor and the cast-iron top is now made by pouring lead or pot-metal into the socket through which the conductor passes, and tamping it in the same way as if

FIG. 9.



TUBULAR EARTH, SHOWING AUTOMATIC WATERING BY RAIN-WATER PIPE.

it were the joint of a water-pipe. The earth connection is now complete; but, in order to make it permanent, and to keep the moistness which is essential, a small piece of pipe is led from the special hole in the casting either to the nearest rain-water pipe, as shown in Fig. 9, or, if this is not available, it is allowed to project above the ground, so that water can occasionally be poured down. The cast-iron cap is, last of all, inserted on the top of the tube, and serves to mark the position of the lightning conductor, a useful precaution, as conductors are often cut by workmen who have no idea of their existence. The system of tubular earth (Fig. 9) is favoured by architects, who naturally object to the deep holes necessary for the usual earth-plate being made near the foundations of a building; it also has the advantage of being considerably cheaper than other forms of equipment.

I will now put on the screen a view of a cemetery chapel at Thirsk which was struck in April, 1900. It is an unprotected building, but was quite in the shadow of the large parish church of St. Mary's which had a lightning conductor. You will see how the flash divided over the building, and, where it ran to earth, there are small upheavals of the ground. In this case the stroke divided up and earthed itself fairly quietly, but in some cases—there is the one of St. Paul's Church, Bedford, which you have seen—the great destruction which took place then was occasioned by there not being adequate earth connections to take the flash which spread all over the roof.

This slide represents a ground plan of St. Paul's Cathedral, and the lines running to the various circles are the conductors running to the numerous earths. Originally I found that the dome alone was protected and the west towers; to shield the building more completely a conductor was run all round and furnished with aigrettes as shown by the small circles, and from this the main down conductors ran to earth and others upwards to the various pinnacles and statues.

The Lightning Research Committee received reports from Germany, also from Hungary, where Dr. Moritz von Horn, of the Royal Joseph Polytechnic University, strongly recommends barbed iron wire, and states that cage lightning conductors are largely in use, both on town buildings and on farms and barns. A very interesting report has quite recently been received from Dr. Van Gulik, of Haarlem. It was made at the request of the Dutch Academy of Science. He also favours the use of iron for conductors, and suggests that the high terminal rods should be abolished. Tables are given to show the number and extent of disasters to protected and unprotected buildings, and particulars of the rebate allowed by some insurance companies where

buildings are fitted with lightning rods. The total amount of damage by lightning in Holland settled for by insurance companies is given as £84,000.

United States.

A visit paid by the author to the eastern cities and Canada was reported to the Lightning Research Committee, as follows:—

"The general opinion was that owing to the very inefficient protection which had been afforded in the past by the contractors who had installed lightning rods on many public and private buildings, it was gradually dropped out of architects' specifications, and at the present time few new buildings are protected at all! they are often struck, but as the insurance policy covers the loss, little notice is taken, although deaths occur either by direct stroke or from chimneys or masonry falling. I was informed that the present conditions were thought to be unsatisfactory, and that architects and engineers generally would like to be advised as to what protection they should adopt. That large amount of damage by fire caused by lightning does take place, is shown by the reports of the Fire Commissioners. The action of lightning when striking those high steel buildings known as sky-scrapers is peculiar, and is worth investigation, as examination does not show in what direction the current flows to earth. In many cases in New York the buildings are insulated from the ground by the fact that the foundation is blasted out of the rock which forms the island on which the city is built."

A slide is shown which illustrates a portion of the framework of a steel building. The author recommended that the roof should be in good electrical connection with the framework and the top, and that the supporting columns should be inter-connected at their base by conductors which were led to a number of permanent earths.

Subsequently I went to Canada, and on the day after my arrival in Toronto, a severe storm took place, which caused several fires from gas ignition, and a flash struck the tower of the fine modern City Hall, shattering the roofing and doing considerable damage. No lightning conductor was installed, but, as I was asked to give my opinion, I think the building has been protected in the way I recommended.

The Lightning Research Committees.—Practical Suggestions.

It is interesting to note that the English Committee are not alone in attaching great importance to this subject. Their general conclusions agree closely with the independent reports of the various continental authorities and committees, some of which have been quoted above, therefore the following suggestions are put forward as not only the results of their own investigations, but also as the practical opinions of all those who have been similarly engaged.

The suggestions appear in the report of April 10th as follows:—

"1. Two main lightning rods, one on each side, should be provided, extending from the top of each tower, spire, or high chimney stack by the most direct course.

"2. Horizontal conductors should connnect all the vertical rods (*a*) along the ridge, or any suitable position on the roof; (*b*) at or near the ground line.

"3. The upper horizontal conductor should be fitted with aigrettes or points at intervals of 20 or 30 feet.

"4. Short vertical rods should be erected along minor pinnacles and connected with the upper horizontal conductor.

"5. All roof metals, such as finials, ridging, rain-water and ventilating pipes, metal cowls, lead flashing, gutters, &c., should be connected to the horizontal conductors.

"6. All large masses of metal in the building should be connected to earth either directly or by means of the lower horizontal conductor.

"7. Where roofs are partially or wholly metal-lined they should be connected to earth by means of vertical rods at several points.

"8. Gas pipes should be kept as far away as possible from the positions occupied by lightning conductors, and as an additional protection the service mains to the gas meter should be metallically connected with house services leading from the meter."

It is hardly necessary to repeat the rules drawn up by the Committee, as they are set forth at length in their report, which gives some of the details necessary to carry out their suggestions. Some of those which were issued by the Lightning Rod Conference in 1882 are retained, and the new recommendations are principally the horizontal conductor on the ridge or summit of the roofs, and the down conductors, which are connected to this and to all metal work, and again inter-connected near the ground level. The necessity of increasing the number of the earths in proportion to the ground area of the building is also pointed out.

The insurance offices appear to disregard the question of adequate protection, and are quite content if the single conductor, which

has not prevented serious damage, for instance, to a church, is replaced, and, moreover, they take no steps to have the earth connection tested periodically. The few unconnected lightning rods erected on our national museums, picture galleries and other public buildings, contrast most unfavourably with the more scientific methods adopted on the Continent, more especially in Germany, where in some districts the local authorities have issued rules as to the erection and testing of lightning conductors, to which the various public bodies have to conform. In some cities householders are subject to penalties if the system is allowed to get out of order.

It appears anomalous that large sums of money should be spent on the protection from fire of our museums, while the question of protection from lightning is simply ignored by the department in whose care they are placed. For instance, the Victoria and Albert Museum has one conductor (it was struck in 1900, but fortunately the damage was confined to the destruction of an electric main, which served as a lightning rod, as it was laid on the wall separating the Imperial Institute from the museum). The National Gallery apparently had no conductor until the flagstaff was erected, and this is the only approach to safeguarding the building from lightning stroke, although many thousands are being spent to buy up the adjoining property. How very differently public buildings are treated abroad is shown by the view of Le Faculté, one of the public buildings in Paris, and of Notre Dame Cathedral. The British Museum authorities rely on the copper roof for protection, and the flagstaff was on my visit unprotected. The Tate Gallery appears to have inadequate lightning conductors, and the system on the Houses of Parliament, originally installed with great care, is said to require attention (the Victoria Tower was struck in 1868). The ecclesiastical authorities are, with some exceptions, indifferent, and having had some rods put up haphazard suppose that they act as a fetish or charm, or as a quack specific to cure all lightning plagues. I have visited some dozen cathedrals in the provinces, and in only one was there any attempt to protect the whole of the structure, and that was at Canterbury, where the arrangement of the conductors was faulty, in that a stroke of lightning which had travelled through perhaps half a mile of space would not, as the generality of lightning-conductor makers expect, tractably follow the copper tape, some of which had almost right-angle bends. However Canterbury stands at the head of the other cathedrals which were inspected in that the conductors had recently been overhauled and rejointed, and the earth connections tested.

At Chester the conductors were insulated and led into loose sockets close to the ground, so that any passer-by could disconnect them from earth. Time will not allow a criticism of all the buildings visited, but I must point out that the well-preserved Minster at York had only three conductors, which, according to imformation received, had not been tested or overhauled for many years. Our cathedrals and museums are of national importance, and if it is found necessary on the Continent to have a thorough system of protection and frequent inspection, surely it should be done here, as the initial expense could be spread over a number of years, and the annual upkeep would be sufficiently provided for by a one per cent. rate on the sum spent for structural repairs. The amount of damage to property by lightning stroke is enormous; unfortunately, owing to the reluctance of the insurance companies to publish details, no figures can be stated. Most people think that almost every church has a conductor, whereas not ten per cent. are so provided; in fact, although there is sometimes a recommendation from the archdeacon that the churchwarden should put up a conductor and see that it is kept in order, if the vicar wishes to safeguard his church the cost usually has to come out of his own pocket. The insurance offices do not seem to care whether a building is protected or not, as no individual office likes to insist on the erection of lightning conductors for fear of diverting business to its rivals.

DISCUSSION.

The CHAIRMAN said the protection of buildings against the effects of lightning had aroused very much interest of late, and had been debated in the Press, some of the writers having gone so far as to question whether buildings could be effectively protected against lightning. Some of the audience having seen the illustrations on the screen of damage which had been done by lightning, might also have come to the same conclusion. If they did, however, he thought they were in error, for wherever man found himself face to face with the greater forces of Nature he was doomed

to occasional failure. Man's best found ships were wrecked, his breakwaters demolished, and railway embankments washed away. He did not on that account abandon his attempts, but, on the other hand, sought improved designs, and went to work again, and generally his efforts were crowned with success. The same conclusion, he thought, might be reached with reference to lightning protection. In the early days of Snow-Harris, and others, lightning rods seemed to have been fairly effective. Cases of failure increased in number as time went by, and these might be attributable to the altered nature of buildings. These enclosed gas and water pipes, wires, and all kinds of conductors, many of them affording a direct path to earth, and the fact of putting such masses of metal and other things in the interior of buildings led to an increased number of disasters. The question had assumed such proportions and importance that in 1878 it led to the formation of the Lightning Rod Conference, which undoubtedly did good work. It crystallised the best practice of the day, called attention to the methods of dealing with conductors in the inside of buildings, and laid down most useful rules. He was afraid, however, that the electrical profession had not formed such a true idea of the character of lightning then, as they had at present. Sir Oliver Lodge was one of the first to take up the question from the point of view of the oscillatory quality of lightning, and he urged the necessity for modified methods. But he (the Chairman) was afraid that for a long time Sir Oliver was like one "preaching in the wilderness." The urgency of the matter did not at first appeal to the general body of engineers, and very few thought seriously of the question, being satisfied generally with the regulations drawn up by the Conference. He thought the attention of engineers was strongly drawn to the subject by modern developments of electrical engineering, more especially that which related to the introduction of wireless telegraphy. That itself depended upon oscillatory currents, or the use of a gentle form of lightning. The two movements were absolutely alike. The oscillations in the wireless installation were the analogue of the oscillations that took place in a lightning conductor. Considering for a moment the best practice in wireless telegraphy; the source of the energy was not connected directly to the vertical wire, which was the counterpart of the lightning rod, but very violent oscillations were established in a closed circuit, the oscillations being imparted to the vertical wire in one case by direct contact, and in the other case by induction between two neighbouring conductors. When very powerful energy was used, those oscillations extended through the line of external conductors, so that on a dark night one could see brush discharges passing off into the atmosphere in the same manner as the lightning effects which were illustrated by the author. On the other hand, the receiving apparatus was not connected direct to the vertical wire, but the connection was either through a secondary circuit, or in some cases by induction. If these facts were considered in connection with many of the cases which had just been illustrated, he thought it might be readily understood how it was that the effect of the violent oscillations in an ordinary lightning rod were not limited to that rod, but acted, either directly on all other conductors which touched that rod, or on those in sufficient proximity as to be affected inductively. The result was that in many cases at the distant end of a metallic ridging, or the guttering that surrounded a building, one would get violent discharges which, if those extremities were connected with earth, would disappear harmlessly. But if they were not so connected, damage would be done and evidences of their action would be left behind. That was a brief explanation of the basis of the work of the recently appointed Lightning Research Committee. He thought that those who were interested in the protection of buildings from lightning might assume that in this country they were not so very far behind the age; that there was no reason to give up hope of effective protection, and that the modern methods, referred to by the anthor, would afford as reasonable a protection as could really be hoped from the mighty forces of disruptive lightning. He thought the use of the lightning rod might be regarded as a species of insurance, not of the type that the author referred to, in somewhat disparaging terms, but that the amount of protection might be proportioned to the value of the buildings themselves. Buildings of no great extent or great capital value could be effectively protected in a cheap manner, but with larger and more expensive buildings and national monuments, a very large expenditure was fully justified.

Mr. J. J. RAWLINGS thought the illustration the author had shown of "Heathfield" exemplified the net-work system as far as it was possible to do so. There was almost an excessive number of points, and a large number of earths, but Mr. Hedges had not said how the earths were made, although presumably he was satisfied with them. It appeared to him that its only difference from a perfect net-work system was that it did not contain horizontal connections. He had been much struck with the important part that lead played in the system, it being stated that the current passed along the lead ridges or gutters; so that one was almost irresistibly drawn to the conclusion that lead would be the proper conductor to use. Its specific resistance was somewhat similar to iron, its lasting power was very great, and it did not possess the bad habit of marking the stone and otherwise disfiguring the building which was characteristic of iron. His firm had consistently made it a practice, especially with tall pipes, such as ventilating pipes, made of lead with soldered joints, to earth the pipes at the foot, thereby obtaining an excellent lightning conductor.

Mr. ALFRED HANDS said there were so many points in the paper to which exception could be taken that it was impossible for him to refer to them all. The author inferred that the views of experts on the question of protection from lightning up to time of the publication of the Research Committee's reports were entirely wrong; that protection under those views was a matter of impossibility, and that only now had the matter been placed in the true light. Mr. Hedges had either failed altogether to realise what the views of experts on the subject were, or else he had ignored them, because there was no resemblance whatever between what he had pointed out as being the views on lightning conductors before the Research Committee was formed and the views of experts. The author had taken the popular idea of people who had never studied the subject, which was absolutely different to the opinion of experts. With regard to the question of damage by lightning, he reminded the audience that an enormous number of cloud-to-earth lightning discharges took place in the country every year; and since very lofty buildings were admittedly more liable to be struck by lightning than low ones—and as practically all the very lofty buildings in the country were fitted with lightning conductors, remarkably few of which were protected in accordance with the author's views—was not it reasonable to suppose that an alarming number of failures of lightning conductors would take place if Mr. Hedges was right and the experts were wrong? From a very close investigation of the subject, extending over the last 17 years, he believed that between 300 and 400 buildings were struck and damaged by lightning every year in the country, out of which less than a dozen possessed lightning conductors. The buildings must have been in existence for terms varying from 20 to 60 years, and the rods had been put up by ironmongers, plumbers, builders, and others, whose callings did not imply that they were experts; and they had never had the slightest attention in the course of that time. Was a lightning conductor to be regarded as the one thing in the world which should remain efficient for half a century without attention or repair, and irrespective of whether it was put up properly in the first instance? The author had laid stress on the fact that the Research Committee received accounts of 125 cases, out of which 40 had lightning conductors; but so far as he could see only 34 were given in the published list, and of that number seven had no lightning conductors at all, although the committee said they did not consider it necessary to give details of the unprotected buildings that were damaged, and confined themselves to giving particulars of the protected buildings. He did not know whether that was a mistake or not; it seemed to him it was given with the idea of making the impression that everybody was wrong on the subject and that lightning conductors always failed. In addition, one case never occurred at all, and if it did take place it happened many years ago, long before the committee was formed. He would like to know whether the list of 40 included the case of damage to the Houses of Parliament, which the author reported to the committee, and for which there was no foundation whatever, and whether there were similar cases among the number. He further contended that the author's remarks with regard to lightning conductors attracting lightning were incorrect, Snow-Harris combating the idea very strongly. The question of side-flash was also not a new one, Snow-Harris referred to the subject half a century ago, although his ideas were not quite correct, present day experts knowing much more about the matter. The cage system was not new, experts having always regarded it as the best system of protection available, provided it could be applied. It was the best system, for the reason that when it was employed in its entirety there was no necessity to examine the inside of the buildings; but it was not practicable. In the first place the cost was prohibitive, and secondly a building could not be protected in the manner unless it was detached. One thing experts knew was that the bastard cage system which the author had recommended was not equally effective; in fact Mr. Hedges had condemned it himself by saying that to protect a building perfectly it was necessary to have a complete bird-cage system, while he recommended what he (Mr. Hands) would call a bastard one. The system was adopted in the Hotel de Ville, at Brussels, but was not composed, as the author stated, of conductors formed of copper wires, but of iron wires,—the very system that was being suggested now, and which, although, the author said was efficacious, failed, the building having been set on fire by lightning.

Mr. HEDGES, in reply to Mr. Rawlings, said the point he wished to emphasise in connection with "Heathfield" was that the conductors were not inter-linked, otherwise the damage would probably not have occurred. He could confirm Mr. Rawlings's remarks that lead was an excellent material to use, by stating that in the Bedford church which was struck by lightning some of the pipes which took the discharge were lead pipes; they were not melted, but only bulged out so that the pipes became oval in shape. He did not think, however, that lead could be generally used owing to its expense. He quite agreed that the lead pipes should be earthed. With regard to Mr. Hands's remarks, he did not wish to blame everybody in the sweeping way that gentleman imagined. The committee did not select the cases of protected buildings which were given; the observers, who were perfeetly neutral, self-appointed gentlemen, among whom was Mr. Hands, performed that function, and if Mr. Hands thought that work was being done in the wrong direction during the four years the Research Committee was in operation, it was his duty to have written to the secretary and complained of the fact. The views he had stated were not his own, but those

of the Research Committee. Mr. Hands had referred to an inaccuracy in the number of cases given. To the best of his belief forty cases were ordered to be inserted in the report; but if any errors had crept into the published report he was only too pleased to have them pointed out, and would make the necessary corrections in the next edition. Even supposing there were only 35 or 37 cases instead of 40, he contended that was a very large proportion of buildings fitted with lightning conductors to be struck by lightning out of the total number which the committee examined. The case in which damage was reported to have occurred at the Houses of Parliament through a stroke of lightning crept in in a very curious manner. In passing down Palace-yard, he noticed that a considerable crowd had assembled, and was told that the Victoria Tower had been struck by lightning. It was very difficult to verify such a statement because the authorities would not allow anybody to inspect the building, but he was told that pieces of flagstones were lying about in the road just at the time. The evening papers all contained statements to the effect that the building had been struck, and as the list was being made up at the time, it was included; but the list was a private document, and was never intended to be circulated, except to those immediately connected with the Research Committee. The entry was immediately erased when it was discovered that the report was a mistake; and he hardly thought it was a nice suggestion to make that the committee had deliberately published false information. It was rather late, now that all the work had been done, for Mr. Hands to condemn it; the work had been very largely advertised, and he was sorry Mr. Hands did not come forward earlier and give the results of his experience. Personally, he had been led to investigate the subject because he could not find anything to guide him, but he did not wish to condemn what other gentlemen had done. He had never had occasion to see any of Mr. Hands's work, but he had carried out a good deal of work in connection with electric-lighting stations, and on examining it he found it was so terribly bad that he determined to start again, and put in appliances which he thought would have a much more lasting effect. He quite understood that firms such as Mr. Hands represented could do good work, and he should be very sorry indeed if it was supposed that he in any way condemned the work done by such firms. Looking at the examples of work which he had shown there were two reasons for the failure, either that the work was not good, otherwise they would not have been struck, or else that the system which had been adopted was not sufficient. He thought that instead of cold water being poured on the work of the gentlemen who had investigated the subject, they ought to be encouraged in their endeavours. It was of primary importance that architects should have it brought to their earnest consideration that if a building cost a lot of money to erect it was worth while spending a good sum of money to protect it. As the Chairman had remarked, it was simply a question of insurance.

Mr. HANDS, in explanation, said that although the document which contained statements connected with the Houses of Parliament was originally marked "private and confidential," it was afterwards exhibited for a period of nearly six months at the Earl's Court Exhibition, with the words "private and confidential" erased, and with the case of the Houses of Parliament not deleted. He therefore thought he was justified in mentioning the matter.

The CHAIRMAN thought he could explain one small discrepancy which had been referred to by Mr. Hands. There were forty cases, but he had personally struck out three of them, because they did not refer to the protection of buildings by lightning rods, but to the protection of telegraph instruments by lightning protectors used for that purpose. He therefore struck them out because he thought they bore no direct relation to the report of the Lightning Research Committee. In conclusion, it was his pleasant duty to propose a hearty vote of thanks to Mr. Hedges for his able paper.

The resolution having been carried by acclamation, the meeting terminated.

IRRIGATION IN CANADA.

From the eastern foot-hills of the Rocky Mountains, at a point 15 miles south of the boundary between Canada and the United States, a ridge or height of land starts out in an easterly direction, crossing over into Canada, and running nearly parallel with the international boundary, about 40 miles north of it, for a distance of something over 400 miles, thence turning in a south-easterly direction through North Dakota. A similar ridge runs out from the mountains at a point about 300 miles north of the United States boundary, in a north-easterly direction, traversing the great peninsula towards the Hudson Bay. Between these two ridges lies the basin of the Saskatchewan, subdivided into the main valleys of the North and South rivers, with the affluents of these. This is the prairie country which in the early part of the last century was known as Rupert's Land, latterly attached to the Canadian Federation as the North-West Territories, and on the 1st of July to become organised provinces of the Dominion. If the measure now before Parliament is passed in its present form, the Province of Alberta will comprise the territory lying west from the fourth grand meridian—line 110 of west longitude—to the easterly boundary of British Columbia; and the territory extending easterly from that meridian to the

westerly boundary of Manitoba will constitute the Province of Saskatchewan.

The area of land embraced in the basin of the Saskatchewans is approximately 150,000,000 acres. Of this perhaps one-third may be described as sand or gravel, with a light covering of soil, not capable of producing any other crop than the wild grass which covers the entire country in the early part of the summer. But there are 100,000,000 acres of rolling prairie land having a fertile surface soil of loam resting upon a cultivable clay, suitable in chemicel constituents for the production of wheat and other cereals. The experience of the last twenty-five years has shown that good crops can be raised in rainy seasons, but there are periods of drought in which agricultural operations are unprofitable. In regard to rainfall there is an important distinction between the north and south valleys. Towards the north, the mountain ranges of British Columbia are traversed by deep valleys, notably those of the Peace and Pine rivers, through which the moisture-laden breezes from the Pacific Ocean pour into the prairie country, ensuring equable and adequate precipitation throughout the northern districts. Very different conditions prevail in the valley of the South Saskatchewan. This is shut off from the ocean winds by a huge rampart of mountains intersected only by narrow ravines or "canyons;" and west of the mountains there is the broad valley of the Fraser River, running north and south, which intercepts and precipitates a large share of the moisture coming inland on the sea breezes.

In the South Saskatchewan valley and a south-easterly section of the north valley, with the 40 mile strip fronting on the United States and tributary to the Missouri basin, there is an area of something over 64,000,000 acres, designated in the Canadian Government reports as the "semi-arid region." The easterly limit of this is shown on the official maps at 106 longitude from the United States boundary to a point a few miles south of latitude 52. The general level of this district rises from 2,000 feet above sea in the easterly section to 3,500 feet in the west. Records kept at observing stations for 18 years show that the annual precipitation of rain and snow varies from 6 inches to 15 inches, the minimum report being from Chaplin, near the easterly limit of this district, at a point 2,202 feet above sea, where the register gives 50 inches as the total precipitation for 9 years, equivalent to an annual average of 5½ inches, or a monthly average of less than ½ inch. Going west towards the head of the valley the rainfall shows a considerable increase, and approaching the mountains the general average exceeds 15 inches per annum.

The most important point established by the Government records is the regular alternation or recurrence of wet and dry periods, each extending over a series of years. As a rule, this alternation comes every fifth year; that is, after four consecutive rainy summers there will follow four dry years. In the rainy summers the prairie soil is capable of producing marvellous crops, but in the dry years all vegetation fails. In the last thirty years farming operations have been attempted in many parts of the district, but without permanent success, except in valley bottoms, or in the vicinity of lakes or ponds supplied from the melting snow. It is now an acknowledged fact that good crops cannot be ensured in the seasons of drought, unless there is artificial irrigation.

Of late years there has been a large influx of Mormons into the upper part of the South Saskatchewan valley. Many of these people had had experience in the cultivation of irrigated lands in Utah, and they soon perceived that the same methods were necessary on the Canadian prairie. They built dams and constructed watercourses, with very little regard for engineering technicalities, but their efforts have been successful in every sense. Large tracts of land which were formerly available only as pasture for a few herds of cattle in the early spring and late in the autumn are now producing heavy crops of wheat and other cereals. The example set by these Mormon immigrants was quickly followed in other sections of the valley, and large areas were soon brought under cultivation. Associations were organised for the purpose of constructing irrigation works on a large scale; and at the present time there are upwards of 500 miles of canals and ditches capable of supplying water throughout the season for an average of 1,000 acres per mile. This does not include the extensive work now undertaken by the Canadian Pacific Railway in the vicinity of Calgary which will bring under cultivation 1,000,000 acres of land included in the original grant from the Government.

The total area in this region of land for which water supply is available in sufficient quantity to provide for irrigation throughout the crop season is officially estimated at 15 per cent. of the whole. This gives something less than 10,000,000 acres of irrigable lands, mainly in the western or upper end of the south branch. The works now under construction in this section will unquestionably cut off a large share of the water supply of the lower part of the valley, and many millions of acres will remain permanently unwatered, except in seasons of abnormal rainfall. These non-irrigable lands, in the words of the official report of 1903, "for all time to come must be devoted to grazing." For this purpose the semi-arid lands are not surpassed by any part of the American continent; the wild grasses mature rapidly in the early part of the summer, and a little later the whole region is one vast hay-field.

In this great treeless plain evaporation is very rapid, especially under the influence of the dry winds coming from the alkali deserts of the far south. The high altitude and the prolonged hours of sunlight in the summer months afford every facility for free radiation. A sudden lowering of temperature comes immediately after sunset, and a

frosty night may follow after a day of almost tropical heat. These summer night frosts are said to be less prevalent in the irrigated districts.

An international question of some importance has arisen in connection with the irrigation schemes in the 40-mile strip bordering upon the United States, and within the southern watershed. The principal watercourse of that district is the Milk River, which has its origin in a small lake south of the boundary, thence crossing over into Canada, and flowing easterly a hundred miles before finally turning southward. On the Canadian side there are large areas of prairie land, which can be fertilised only by the waters of this river, and on the United States side there is a similar stretch of country, which has a pressing claim upon the same source of supply. The Washington Government is undertaking very extensive work for the purpose of irrigating its lands in that vicinity, and has taken steps to provide the necessary head of water by building a dam across the outlet of the upper lake. This practically shuts off the supply from a hundred miles of Canadian territory. A Joint Commission has lately been appointed by the two Governments to investigate and come to some understanding respecting this and several other questions of similar nature which have arisen from the alleged diversion of international waters.—*The Engineer.*

LABOUR STATISTICS.

The tenth abstract of Labour Statistics of the United Kingdom just issued (Cd. 2491), presents in convenient form a mass of information of interest to the sociologist. Turning first to trade unions the returns show that between 1892 and 1903 they increased in number from 1,188 to 1,294 in 1896, when the total membership was 1,502,714. After 1896 there was continuous decrease until 1903 when the number stood at 1,166, but the total membership had increased to 1,902,308. Taking 100 of the principal trade unions, the membership increased from 902,763 in 1892 to 1,133,640 in 1903, the income from £1,462,386 to £2,073,612, the expenditure from £1,433,111 to £1,895,015, and the funds from £1,573,944 to £4,550,775. the amount per member at the end of 1903, £4 0s. 3½d., being the highest on record, and comparing with £1 14s. 10½d. in 1892. All the principal trade unions show a large increase of membership with the exception of the clothing unions. Between 1892 and 1903 the building unions increased their membership from 132,934 to 204,060, the mining and quarrying from 203,800 to 266,968, the metal, engineering, and shipbuilding from 177,692 to 244,691, the textile from 107,164 to 116,654, but the clothing fell from 64,512 to 45,353. So with income. All show large increases with the exception of the textile and clothing, the one falling from £192,881 to £186,545, the other from £68,587 to £60,791, but whilst the expenditure of the textile unions fell from £225,203 in 1892 to £205,607, the clothing unions show a slight increase from £61,748 to £62,031.

The expenditure on chief benefits necessarily varies very much. Taking the 100 unions, the highest percentage spent in dispute benefit was in 1897, when 34·7 per cent., or £659,079, was spent in this way. The highest percentage under this head is found in the mining and quarrying section, where in 1893 no less than 66·4 per cent. of the expenditure was for dispute benefit, and the average percentage of the 12 years was 32·9. The dispute benefit paid by the printing and allied trades is the lowest, being little over 5 per cent., and, taking the last 5 years, under 4 per cent.; but, whilst the mining and quarrying unions pay nothing for superannuation benefit, and in 1903 their "working and other expenses" reached 27·8 per cent., the unions of the printing and allied trades spent 21·2 per cent. in superannuation benefit, and their percentage of working expenses was only 16·8. The financial position of the principal unions was never so good as at the present time. Without exception their funds at the end of 1903 were greatly in excess of what they were in 1892, having increased in the aggregate from £1,573,944 to £4,550,775. The building unions had increased from £169,956 to £475,290, the mining and quarrying from £305,383 to £1,020,002, the metal, engineering, and shipbuilding from £578,317 to £1,562,942, the textile from £174,997 to £664,920, the printing and allied trades from £77,923 to £170,994. Even the clothing unions improved their position from £54,717 to £98,016.

The registered friendly societies also show continuous and great expansion. Taking all classes making returns, the ordinary friendly societies, the collecting friendly societies, and the special classes of friendly societies, the membership increased from 10,934,144 in 1897, with funds amounting to £35,736,250, to 13,344,494 in 1902, with funds amounting to £44,848,575. The Manchester Unity, Oddfellows, who, in 1886, had a membership of 550,729, and an income of £969,754, had in 1903 increased their membership to 755,982, and their income to £1,492,352; and the Ancient Order of Foresters who in 1886 numbered 594,921, with an income of £892,613, had in 1903 increased their membership to 664,519, and their income to £1,357,777. In 1903, the total accumulated funds (exclusive of foreign branches and of "female" and "juvenile" branches) of the Manchester Unity of Oddfellows stood at £10,277,366, and of the Ancient Order of Foresters at £6,748,682, and the total benefits of all kinds paid on account of male adults by the one society was £925,712, and by the other, £838,213. On the other hand, building societies have decreased in number. Taking the years following the passing of the Building Societies Act, 1894: in 1895, the number of societies making returns, in England and Wales, was 2,181, with total liabilities of £40,597,050. In 1903, the number had dwindled to 1,861, but the liabilities had

increased to £48,243,848. The loan societies, that is to say the societies registered under the Loan Societies Act, 1840, steadily dwindle. In 1885 they numbered 408, in 1902 only 254. In 1885 the membership was 41,065, in 1902 it had fallen to 32,684. The number of borrowers to whom loans were granted in 1885 was 82,655, in 1902 to 54,322. The amount in borrowers' hands at the end of 1885 was £299,481, at the end of 1902 it had fallen to £202,859, whilst the amount due to depositors and shareholders had decreased from £321,157 to £242,405. Workmen's co-operative societies show steady increase. In 1888 there were 1,447 in existence, in 1903 2,291. Of these, 1,263 made returns in 1888, and 2,027 in 1903. The number of members in the societies making returns increased from 891,088 in 1888 to 2,085,731 in 1903, the percentage to the population of the United Kingdom from 2·4 to 4·9, the share capital from £9,757,269 to £26,596,373, the loan capital from £2,129,059 to £7,989,443, the amount of sales from £33,632,224 to £87,975,651. The number of accounts open in the Post Office Savings Banks in the United Kingdom shows large and continuous increase from 4,220,927 in 1888 to 9,403,852 in 1903; those in the Trustees Savings Banks having increased from 1,579,546 to 1,689,617 only. But the amounts received from depositors in the United Kingdom, whilst showing steady increase from 1888 to 1902, as from £20,385,064 to £45,607,672 in 1902, showed some decrease, falling in England and Wales from £41,117,126 to £39,854,156, and in Scotland from £1,176,469 to £1,699,716. It is worthy of note that in Ireland there has been uninterrupted increase from £1,191,178 in 1888 to £2,762,222 in 1903.

The percentage proportion of working population involved in disputes shows a gratifying decrease, taking the decade 1893-03. In the earlier year the percentage was 7·5, in 1903 only 1·2. If coal mining disputes were excluded the percentage would be very small. In 1893, the coal mining percentage was 74·7; in 1894, 31·2; in 1895, 25·2; in 1902, 25·5. In no other trade throughout the period was the percentage higher than 8·6, which it reached in the clothing trade in 1895, the metal, engineering, and shipbuilding coming next with 7·8 in 1897. The aggregate duration of disputes in working days, which, in 1897, was 10,345,523, and in 1898, 15,289,478, fell last year to 1,416,265. Taking the causes of disputes, by far the largest number is due to demands for increase of wages, next against decrease, wages disputes accounting in 1893 for as much as 90·8 per cent. of the whole, and 58·9 in 1904. Other causes of dispute are concerned with hours of labour, employment of particular classes of persons, working arrangements, and trade unionism.

BELGIAN CHICORY.

During the months of January, February, and March attention is attracted to the immense quantity of a special vegetable sold by marketmen, greengrocers, and hucksters, and eaten by all classes throughout Belgium, prepared in various appetising ways, and frequently eaten as a salad, either raw or cooked. This is the white chicory, the cultivation of which is a speciality of Brussels and its suburbs. There are two species of chicory grown in Belgium. The wild chicory, cultivated in the neighbourhood of Roulers, Thourout, and one or two other localities, in close proximity to the chicory manufactories, where the roots of the plants are parched, ground, and sold loose or in half-pound packages, to be used in connection with coffee, especially by the working classes. The white chicory was originally brought to Belgium from India, and the principal centre of cultivation, according to the American Consul at Brussels, is in the immediate neighbourhood of Brussels, especially in Schaerbeek, Evere, and Woluwe. The root of this plant is of inferior quality and is consequently used as cattle food. The growing of this essentially winter vegetable requires great care, trouble, and hard work, beginning early in April, when the seed is sown. As soon as the plants are an inch and a-half high, they are carefully thinned out by hand, leaving the most vigorous undisturbed, a given distance apart. In September and October, when the plants are in full maturity and the leaves are very long, they are taken out of the ground, and the leaves carefully cut off about two inches from the ground. Trenches are prepared, and the plants are disposed of in them in three layers, each layer being covered by ten inches of earth and from twelve to fourteen inches of horse manure. This manure produces artificial heat, which causes the chicory to sprout, and the earth being compactly pressed upon the plants, the leaves adhere closely together, and as no sunlight penetrates the covering, the plants are bleached white, and present a most attractive and appetising appearance when removed for consumption. This is done according to the demands of the market. The vegetable is available all the year round, but the most active demand is in the months of January, February, and March, during the scarcity of other garden vegetables. The above-described method of bleaching chicory has existed since the commencement of the cultivation of this popular vegetable, but much complaint is heard concerning it principally on account of the germs contained in the horse manure, which is likely to render the vegetable unwholesome and unfit for consumption, and also on account of the danger of a sudden frost, which, by lowering the temperature of the manure covering, checks the growth of the plants, and correspondingly affects the selling price. To combat these inconveniences, the cultivators of chicory at Schærbeek, one of the most important suburbs of Brussels, have for some time been experimenting by heating the layers of plants by the system of thermo-syphons. The system has the advantage of giving a regular, constant heat, and greatly reduces the manual labour connected with the cultivation. Although an immense quantity of

chicory is consumed in Belgium, the yield is sufficient to supply Paris with large quantities, where it is largely used in the hospitals of that city. The average wholesale selling price in Belgium is about two pence per pound, and in Paris about double that price. To perform all the different operations connected with chicory growing demands hard work and constant attention. The most dangerous part of the work is the loading and transportation of manure which has to be done before eight o'clock in the morning. The great difference in the temperature of the cavalry and other stables, where the horse manure is obtained, and the temperature of the outside cold and chilly morning air, frequently results fatally to the men employed in this work.

FRUITS AND CEREALS OF WESTERN AUSTRALIA.

The Agent-General for Western Australia opened on May 1st, at his offices, 15, Victoria-street, Westminster, a small exhibition of apples and cereals received from the State.

It is officially stated that the object of the Agent-General in making this display is:—

1. To illustrate the fact that Western Australia has other claims upon public attention than her gold production.

2. To demonstrate the possibility of the creation of an important export trade in agricultural products with the Mother Country, in proof of which he is pleased to say that a cargo of 5,000 quarters of wheat shipped per ss. *Chili*, by the West Australian Producers Co-operative Union, Limited, has just been sold by Messrs. Berry, Barclay and Co. at 31s. per 480 lbs. (this being the first large consignment of Western Australian wheat placed upon the English market), and that a second consignment per ss. *Suffolk* is being sold at 33s. 6d. per 496 lbs. *ex store*, and

3. To give prominence to the policy of his Government in encouraging the emigration to Western Australia of suitable settlers.

Three kinds of apples, viz., Cleopatra's, or New York pippins, Dunn's seedlings, or Munro's favorites, and Jonathans were received from Katanning (on Great Southern Railway, about 225 miles from Perth), and the Darling Range (about 10 miles from Perth.)

Reports from fruit brokers have been received—Messrs. Keeling and Hunt, of Monument-buildings, E.C., say:—"Condition on arrival—almost pefect; quality all round—very good; size—generally too large for market purposes." Messrs. Yuill and Co., Limited, of 120, Fenchurch-street, E.C., report that:—"The fruit was in splendid condition and of exceptionally good quality."

The wheat, &c., come from the Government experimental farms, Hamel (on the South Western Railway, 71 miles from Perth); Narrogin (on Great Southern Railway, 162 miles from Perth); Chapman (on the Northampton Railway, 337 miles from Perth).

Hamel sends 51 varieties of wheat, 10 oats, 3 barley, 1 rye, 8 maize, 1 peas, and 1 linseed. Narrogin sends 9 varieties of wheat (including sample which won the Kangaroo Cup), and 1 malting barley. Chapman sends 10 varieties of wheat in sheaves and grain, 4 oats in sheaves.

BOLIVIAN FOREST PRODUCTS.

The immense Bolivian forests on the eastern portion of the Republic abound with excellent timber, but no effort has been made so far to develop this industry which is expected to yield handsome profits to promoters. Ebony, mahogany, cedar, rosewood, satinwood, walnut, hemlock, beech-wood, holly, boxwood, "colo," are extremely hard wood not affected by moisture of any kind, "jacarandi," a remarkable wood of variegated colours, and the quebracho, a species of ironwood used for sleepers on account of its extraordinary resistance, are among the few known species of forest products. In Bolivia, according to a recent report of the Bureau of American Republics, there is to be found a great variety of dyewoods and precious medicinal plants, from which may be distilled fine essential oils, while the mountain slopes, hills, and valleys abound in valuable construction and cabinet woods. The celebrated ironwood tree attains a height of over 50 feet, and a circumference of nearly three feet. The specific gravity of this exceedingly compact and durable wood is 1·250, and the contents of tannin 26 per cent. This wood is used extensively for railroad ties, posts, &c., and is employed in considerable quantities in tanneries. Another valuable product of the Bolivian forests is the tree known as "Corupan," which grows to a height of about 60 ft., and attains a diameter of over 3 ft. The wood of this tree does not decay when immersed in water, which quality renders it exceedingly valuable for use in the construction of ships, bridges, and hydraulic work. It makes a very durable railroad tie, and the bark, which is very thick, contains about 25 per cent. of tannin. The tree secretes an abundance of gum arabic, and is one of the most valuable and highly prized productions of the Bolivian forests. "Lapach" is a tree noted for its great beauty and usefulness. It grows to a height of about 60 ft., and has a circumference of trunk of about 3 ft. When sawn into lumber or beams it is greatly esteemed for building purposes, and is especially suitable for use in the building of hydraulic works and for railroad ties. There are four varieties—the grey, the yellow, the red, and the black—all of which may be distinguished while in bloom by the colour of their flowers. The bark is rich in tannin, and the wood is utilised in the manufacture of dyes. "Mumday" is a greatly prized Bolivian tree, and is suitable for railroad ties, telegraph poles, and general building purposes. There are three varieties—white, yellow, and black. It is also a dyewood.

GENERAL NOTES.

CANALS AND WATERWAYS.—The advantages offered to many classes of goods by water transportation is illustrated anew in Mr. Consul-General Hearn's report on the trade and commerce of Havre and district (Annual Series 3368) just issued. Rouen is one of the points of access to the almost perfect system of canals and rivers which France possesses, giving uniform depths for navigation over great distances. As an example, the shipment of feldspar from Norway to the central part of France may be taken. Feldspar of the same quality as that brought from Norway is found in great quantities about 100 miles from a large button factory situated on the Canal de Briare, in the Department of the Loire. There being, however, no canals or waterways connecting the district where the crude article is found with that in which the button factory is situated, it was found more advantageous to bring the Norwegian article to Rouen by sea, then transfer it directly into lighters, and forward it by waterways into the central part of France to the button factory. During 1903, 1,252,632 tons of merchandise were shipped from Rouen by canal into the various districts in France, part going beyond the frontiers into other countries, over 50 per cent. of the shipments being foreign importation *viâ* Rouen, and 336,184 tons of merchandise were brought to Rouen by canal during the same period. The statistics for 1904 are not yet completed, but the Consul-General is informed on good authority that the canal and river shipments to and from Rouen exceed those of 1903.

INTERNATIONAL EXHIBITION OF PEDAGOGY AT BARCELONA.—An International Exhibition of Pedagogy, under the patronage of the King of Spain and of Queen Maria Christina, will be held in Barcelona from May to October, 1905. Particulars as to the scope of the exhibition and the conditions attaching to exhibits are given in the official programme, a limited number of copies of which can be obtained on application to the Director of Special Inquiries and Reports, Board of Education Library, St. Stephen's House, Cannon Row, Whitehall, London, S.W.

MEETINGS FOR THE ENSUING WEEK

MONDAY, MAY 29...National Indian Association, Jehanghir Hall, Imperial Institute, S.W., 4½ p.m. Annual Meeting.

Surveyors, 12, Great George-street, S.W., 3 p.m. Annual Meeting.

TUESDAY, MAY 30...Optical Convention, Northampton Institute, Clerkenwell, E.C., 8 p.m. Opening Ceremony and Conversazione.

Royal Institution, Albemarle-street, W., 5 p.m. Rev. Henry G. Woods, "Velasquez." (Lecture II.)

Horticultural, 1 p.m. Flower Show in the Inner Temple-gardens.

WEDNESDAY, MAY 31...Optical Convention, Northampton Institute, Clerkenwell, E.C., 10 a.m. Reading of Papers and Discussion.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JUNE 1...Optical Convention, Northampton Institute, Clerkenwell, E.C., 10 a.m. Reading of Papers and Discussion.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. J. A. Fleming, "Electromagnetic Waves." (Lecture II.)

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. F. B. Power and M. Barrowcliff, (a) "The Constituents of the Seeds of Hydnocarpus Wightiana and of Hydnocarpus Anthelmintica. Isolation of a Homologue of Chaulmoogric Acid;" (b) "The Constituents of the Seeds of Gynocardia Odorata." 2. Mr. A. E. H Tutton, 'The Relation of Ammonium to the Alkali Metals. A Study of Ammonium Magnesium and Ammonium Zinc Sulphates and Selenates." 3. Messrs. M. C. Forster and H. E. Fierz, "Camphorylazoimide." 4. Messrs. G. T. Morgan and W. O. Wootton, "Influence of Substitution on the Formation of Diazioamines and Aminoazo-compounds. Part III. Azo-derivatives of the Symmetrically Di-substituted Primary Meta-diamines." 5. Mr. G. T. Morgan and Miss F. M. G. Micklethwait, "Diazo-derivatives of Mono-acylated Aromatic Para-diamines." 6. Messrs. H. E. Armstrong and W. Robertson, "The significance of Optical Properties as Connoting Structure; Camphorquinone—hydrazones—oximes; a contribution to the Chemistry of Nitrogen." 7. Mr. W. Robertson, "Solubility as a measure of the change undergone by Isodynamic Hydrazones. (1) Camphorquinonephenylhydrazone. (2) Acetaldehydephenylhydrazone." 8 Mr. T. M. Lowry, "The Design of Gas-regulators for Thermostats." 9. Messrs. H. A. D. Jowett and C. E. Potter, "The Constitution of Barbaloin." Part I. 10. Messrs. G. T. Morgan and A. Clayton, "Influence of Substitution on the Formation of Diazoamines and Aminoazo Compounds. Part IV. 5-bromo-*as*(4)-dimethyl-2:4-diamino-toluene." 11. Messrs. F. D. Chattaway and W. H. Lewis, "The Action of Hypobromous Acid on Piperazine." 12. Messrs. W. A. Tilden and J. A. Stokes, "The Action of Magnesium Methyl Iodide on Pinene Nitroso-chloride." 13. Messrs. A. McKenzie and H. B. Thomson, "Racemisation Phenomena during the Hydrolysis of Optically Active Menthyl and Bromyl Esters by Alkali."

FRIDAY, JUNE 2...Optical Convention, Northampton Institute, Clerkenwell, E.C., 10 a.m. Reading of papers and discussion.

Royal Institution, Albemarle-street, W., 9 p.m. Mr. George Hentschel, "Personal Recollections of Johannes Brahms."

Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Lecture on "Marble Carving," with demonstration.

Geologists' Association, University College, W.C., 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, JUNE 3...Optical Convention, Northampton Institute, Clerkenwell, E.C., 10 a.m. Conclusion of Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Savage Landor, "Exploration in the Philipines." (Lecture II.)

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FRIDAY, JUNE 2, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner-circle, Regent's-park, on Tuesday evening, the 4th of July, from 9 to 12 p.m.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club-house will be open.

The Reception, by Sir William Abney, K.C.B., F.R.S., Chairman, and the other Members of the Council, will be held at the entrance to the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

The Tropical House, containing the Giant Water Lily (Victoria Regia), Banana, and other interesting tropical plants, will be open to visitors.

An Exhibition of Economic Plants, &c., grown in the Gardens of the Royal Botanic Society, together with specimens from that Society's Museum, will be on view in the Corridor.

A Selection of Music will be peformed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Grenadier Guards in the Gardens, commencing at 9 o'clock.

Two performances of Selections from Pastoral Plays will be given in the Gardens by Mr. Patrick Kirwin's Idyllic Players at 9.30 and 10.30 p.m.

A concert and entertainment, including the screen scene from "The School for Scandal," will be given in the Club-house, from 10 to 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the *Conversazione.* On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal,* cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

The MAHARAJA GAEKWAR, before introducing Mr. Tozer, thanked the Council of the Society for having invited him to preside over the meeting The author of the paper required no introduction. He had on a previous occasion read a paper befor the Society, and was a well-known authority on the subject.

The paper read was—

THE MANUFACTURES OF GREATER BRITAIN.—III. INDIA.

By Henry J. Tozer, M.A.

In this series of papers, dealing with the manufactures of Greater Britain, it is my privilege to set forth the position of India. The proclamation of Queen Victoria as Empress of India in 1877 was a striking recognition of the fact that India is an Empire within an Empire—that India, more than any other portion of the British Empire, gives the Empire its Imperial character. In virtue of her ancient civilisation, her vast population, her enormous productive power, and her generous contributions in men and money to the defence of the Imperial fabric, India may justly claim the first consideration after England herself.

Great diversity of climate and large tracts of fertile soil enable India to produce abundant and valuable crops, and to carry on an active internal and external trade. According to a Parliamentary paper (342/04), the sea-borne commerce of India in 1902-03 was greater than that of Canada and Australia combined, as the following figures show (in millions of £s):—

	Imports.	Exports.	Total.
India......	74·1	92·7	166·8
Canada....	27·4	33·2	60·6
Australia ..	37·8	48·2	86·0

In 1903-4, the trade of India reached £200,000,000, and even this high figure has certainly been much exceeded in 1904-5. In Coronation year an inscription on a cereal arch erected in Whitehall claimed that Canada was the granary of the Empire. But that position is really held by India, which is too modest or too unenterprising to advertise. During the last three years India has supplied England with 51,384,000 cwt. of wheat, while Canada has furnished only 26,525,000 cwt. of wheat and 6,627,000 cwt. of flour. Again, if we regard the three great countries as markets for British produce, we find that in 1904 the purchases of Canada and Australia together amounted to only £27,868,000, while those of India were £40,617,000, or nearly 50 per cent. greater. In 1904 also India bought no less than one-third of Lancashire's exports of cloth. One great reason why so many British goods find their way to India is to be discovered in the second fiscal Blue-book of the Board of Trade (2337/04), which shows that the average duties levied on imported British manufactures are 17 per cent. in Canada, 9¼ in New Zealand, 6½ in Australia, 6 in South Africa, and only 2¾ per cent. in India. The chief British import into India, viz., cotton cloth, pays only 3½ per cent., and a countervailing excise duty is imposed, but in Canada similar goods pay 17 to 23 per cent. and no excise duty is levied. The one duty is for revenue, the other for protection, largely against British manufactures. I can only advert to the extensive interests that England has in India owing to her investments of hundreds of millions of capital, and to the large numbers of Englishmen employed in the army and civil service and in mercantile pursuits. And last, but not least, it must be remembered that India contributes 150,000 men and £20,000,000 in money to Imperial defence—an item that cannot be disregarded, as it is ultimately a charge on her industries.

India resembles the self-governing colonies in being mainly agricultural, but she differs from them in having a large and closely-packed native population. While India contains 300,000,000 people, or about three-fourths of the whole population of the British Empire, Canada has only 5,371,000, and Australia 3,776,000, the respective densities per square mile being 167, 1½, and 1¼. The character of the different populations, needless to say, differs enormously. The natives of India cling to their primitive methods and customs with the most tenacious conservatism. They remain Oriental in spite of long permeation with European ideas. There are of course distinguished exceptions, and I need not remind this audience how prominently His Highness the Chairman has stood forth among the princes of India as an advocate of education, of social reform and of industrial progress. Some of the innovations due to British rule—such as railways and cotton mills—have to a certain extent affected the population throughout India, but probably British influence has not penetrated very deeply. To the British, and still more to the Colonial mind, the most unintelligible fact is the Indian's lack of any desire to "get on." He has no ambition to raise his standard of living, and his wants now, as in the past, are few and simple. This is the key to the whole economic position in India. External pressure may be breaking down caste in certain directions, but caste and family traditions and love of ease still preclude any eager pursuit of gain. Even wealthy merchants often confine themselves to strict necessaries, caring nothing for

the comforts and conveniences that even a poor European would require. It is true that there is a growing demand for certain European goods, but they are mostly in substitution for similar but dearer and inferior native articles. Despite apparent exceptions the broad rule is that the Indian has few wants and a low standard of comfort. Given this primitive economic condition, it is not surprising that the range of imported goods is small, that manufactures are in a rudimentary stage of development, and that they play a very minor part in comparison with agriculture, to which, in fact, they have always been closely subordinated. It is on the improvement of agriculture, indeed, that any considerable development of manufactures must depend. The agricultural population have now very little margin for the purchase of manufactured goods, nor will they have any until they can enhance the productive power of the soil. It has to be remembered, then, that for any period worth considering the tastes and the effective demand of the agricultural classes must be the dominant factors in industrial development.

The existing Indian manufactures are, roughly speaking, either the products of the ancient village handicrafts, or the machine-made products of mills that have grown up in the cities under European influence. That only 10 per cent. of the people of India live in towns is in itself a clue to the industrial condition of the country. Owing to their corporate connection with the village community and to their great numerical superiority over factory workers, the rural artisans still play a predominant part in manufactures. But though they know and can cater for the precise wants and tastes of their customers, their position is being undermined by the influx of finer and cheaper goods from British or Indian mills. With the growth of capital, the diffusion of education and technical skill, and the extension of railways, it is probable that modern methods of manufacture will more and more supplant the ancient rural industries. But before dealing with the factory industries, it will be well to note the effects that have already been produced on indigenous industries by the invasion of manufactures produced by modern processes. Perhaps I may say here that all general statements about a country so large as India must be accepted with caution, though I have endeavoured to generalise as accurately as possible from a great mass of detail.

The Decay of Handicrafts.

Ninety per cent. of the population depend on agriculture and on about 25 occupations closely associated with rural life. Hand-loom weaving is easily first, followed by carpentry, shoemaking, pottery, building, oil pressing, metal working, &c. These industries, supplying the simple needs of primitive communities, are conducted on traditional lines. Until lately the artisans have had little inducement to improve their work in quality or finish, and with a subsistence practically assured inventive power and mental concentration could hardly be expected. The industrial competition that is affecting handicrafts is increasingly from India itself. To the village weaver it is immaterial whether he is squeezed out by the Bombay or the Lancashire mills. Leaving the case of the hand-weavers for special notice, we may refer to the oil-pressers, whose production of oil for lighting purposes has been diminished by the invasion of cheap kerosine. The kerosine tin, even, plays a part in the displacement of ancient industries, for it is used for storing *ghi* instead of the bag made by the native leather worker, and it is also used for boiling water. The village shoemaker prefers to buy leather from the large modern tanneries rather than the inferior products of the many small native tanners, whose existence has thus become precarious. The shoemaker himself, however, is in many parts suffering from the importation of foreign shoes. The cheaper and less troublesome aniline dyes are superseding the native vegetable dyes in the widely distributed craft of dyeing and calico printing, and dyeing in factories has increased. In pottery, again, we find the influence of new processes, for earthenware vessels are giving way before cheap European glass and chinaware or enamelled ironware. European knives, axes, lamps, &c., are driving out the inferior productions of the village artisans. Iron smelting by crude and expensive methods is disappearing before the imports of cheap European iron and steel, which can be more easily shaped into pans, buckets, and agricultural implements. Coarse silks and woollens are to some extent being ousted by imported goods, as also roughly made glass and paper. Above all, the sewing machine, which is at work in every bazaar, must have saved much mere manual labour besides supplying new demands for made-up garments. It would seem from the last census report that in the

Punjab the village industries are far more firmly established than the urban ones, but taking India as a whole it is clear that the old order is changing and that several of the time-honoured village handicrafts are succumbing before the inroads of machine-made goods.

The Present and Future of Hand Spinning and Weaving.

After agriculture the hand-weaving of cloth is by far the most important occupation throughout India, two-thirds of all artisans being thus engaged. While the cotton mills, according to the 1901 census, employed about 186,000 persons, the hand industry comprised 3,369,000 spinners, weavers, dyers, &c., representing, with dependents, a total of 6,495,000. The Famine Commissions of 1880, 1898, and 1901 all drew special attention to the position of the weavers, and emphasised the importance of maintaining all crafts that afford a subsistence independent of agriculture.

The introduction of steam power naturally encroached first on the primary industries, diminishing the numbers occupied in ginning, cleaning, and pressing cotton, which are increasingly done in small factories, and in hand-spinning. Sometimes hand-spinning is referred to as a thing of the past, but the census shows 90,300 men and 509,200 women as engaged in it, while the agricultural returns estimate the local consumption of raw cotton as at least a million cwt. As an employment for the poorest class of women who can do nothing else or who spin between other occupations, hand-spinning may go on so long as yarn fetches any price above that of raw cotton. In villages remote from railways home-spun yarn can be sold at a profit, and although coarser, rougher, and less even than machine yarn, these very defects cause it to be preferred for wraps, quilts, &c., since it makes the cloth heavier and warmer as well as more durable than mill yarn of equal price. Only, however, in coarse descriptions can the hand-spun yarn compete successfully. Professional weavers rarely use it, preferring yarn from local mills for counts averaging 20 s, and English yarn for higher counts.

Hand-weavers exist in every Province and State, nowhere very flourishing, and usually hard pressed by the competition of machine-made cloths. This competition is not new, for 50 years ago, with a smaller population, the imports of cotton manufactures were valued at £5,400,000; but now the imports are £19,246,000, while to this must be added the output of Indian mills. In 1901 there were 1,836,400 male and 832,600 female hand-weavers, and only 172,000 were described as partially agriculturist. The great majority are hereditary craftsmen who usually exist in communities in considerable towns. Most of them are at the mercy of rapacious cloth merchants who finance them and take finished articles in repayment of advances. To a large extent the hand-looms and the mills supply different wants, the coarse and durable cloths of the former being preferred in many parts by field workers, while the more delicate products of these looms are bought by the wealthier natives. The mills compete with neither of these kinds of goods, but mainly supply plain cloths of finer texture to the middle classes. The exact condition of the hand-weavers appears to vary considerably in different parts. In Bengal, weaving is said to be decaying as a separate industry, and many weavers have taken to agriculture, mill-work, shop-keeping, or money-lending. English cloth is there replacing the stronger, and coarser native cloth, though the poorer Hindus from economy, and the more orthodox ones through conservatism, cling to the simple loom-made garments instead of following the ordinary well-to-do natives in adopting made-up garments in European fashion. In Assam, too, fine fabrics, more or less ornamental, are in good demand by the richer classes. The fortunes of hand-weaving in Madras seem very variable. Weavers of coarse cloths have the more regular work, but the competition of mill-made goods keeps their earnings at 3 to 6 annas a day, the latter rate implying long hours and the assistance of women and children. Weavers of fine cloths are said to make from 6 to 10 annas a day *when at work*. At the large weaving centre of Salem, the weavers make five or six annas a day by turning out ordinary cloths of 40 s to 80 s with old appliances, while at Coimbatore numerous artisans with antiquated looms weave yarns of 180 to 200 s into cloths and turbans, and, having plenty of work, earn eight annas and upwards. It is said that Lancashire cannot compete with the hand-made Madras handkerchiefs which are largely exported to England, and for which the demand is reported to be greater than the supply. In the Punjab mill-made cloths are used only by townsmen and well-to-do villagers, most people preferring the cheaper and more durable hand-made cloths. On the other hand, the machine-made cloths prevail in the United

Provinces, because neater, more even, and more attractive. The earnings of hand-weavers in this part of India are only 2½ annas a day, or less. In the Central Provinces ordinary articles of apparel (dhotis for men and saris for women), are woven by hand, though English cloth is preferred for shirtings, caps, &c., because cheaper and thinner. In Bombay Presidency the domestic handicrafts are chiefly important in saris and turbans, the best designs being those of Surat and Ahmedabad. Many fine hand-made goods are exported to Persia, Arabia, &c. The fabrics are either various scarf or plaid-like articles of dress which leave the loom ready for wear, or piece-goods for making up into clothing. All but a few conservative natives use the latter. Men's garments (dhotis) are usually mill-made, while women's saris and cholis (bodices) are largely hand-woven. In shirtings, long cloths, and sheetings the mills are supreme and turn out steadily improving qualities. Although some have drifted into the mills, many hand-weavers—chiefly Mohammedans—still practice their craft even in Bombay city. One of those whom I questioned at the Bombay Industrial Exhibition said that while there is a God above he did not fear the mill competition. Yet he admitted that saris had fallen in price from 6 to 1½ rupees—though part of the fall was due to the use of the cheaper machine-spun yarn. In Bombay 6 annas a day are said to be the usual earnings of a hand-weaver. All statements of earnings, however, are doubtful. One does not know if they are gross or net, if they are regular or not, and if they include aid rendered by the family. Again, prices of raw material fluctuate and the cost of living varies in different provinces, and in town and country.

For some years Mr. Havell and others have advocated the improvement of the antiquated hand-looms now generally used. Although hand-weaving is unquestionably decaying through the larger use of mill-made cloths as the railways extend, the industry is nevertheless widespread and has apparently enough vitality to last for many years. The rich and the poor still tend to prefer hand-woven cloths for different reasons, while the mill industry, though advancing, progresses at no extraordinary rate. It is a matter of grave concern whether the great majority of the hand-weavers, whose outturn is worth many crores of rupees, should be driven into agriculture after a prolonged period of grinding poverty or whether some action should be taken to better their position by improving their methods and machinery. For every mill-weaver there are said to be thirty hand-weavers, and as their standard of subsistence is low, they can compete more or less successfully with the machine-made cloths. Many believe that by the improvement of hand-looms India could produce most of the cotton goods now imported, or at least that an industry now decadent may be benefited if it cannot ultimately be saved. The native loom can be easily fitted with a fly-shuttle, with which weaving can be done twice as fast and cloth of much greater width produced. The fly-shuttle can be attached at a cost of 10 rupees, and a weaver can become expert in its use in one month. Some progress has already been made in popularising the appliance. The Bengal administration report for 1903-4 says that the improved loom is coming into more general use, and to it is ascribed the vitality in the hand-weaving of common cloths at Serampore. No fewer than 25 district boards in Bengal have taken steps to encourage the extended use of this loom. The Basel Mission factories at Calicut and elsewhere, employing about 900 weavers at 4 to 7 annas a day, have long made excellent cloth at a good profit with the improved looms. In the Jubbulpore jail it is found that the fly-shuttle loom is a conspicuous success. Recently a Japanese hand-loom is said to have been used with great success at Amritsar. The Madras School of Art has found by long experiment that fine cloths of 100 to 120s can be made with the improved loom, while even finer yarns can be woven if a modern warping and sizing plant be combined with it. The improved loom requires a better warp owing to the extra strain. But, generally speaking, the fly-shuttle is no better than the ordinary one for finer cotton and silk goods, except in the case of wide fabrics, though it is excellent for common cloths, such as sheeting and towelling. In opposition to the fly-shuttle loom it is argued that too much exertion is required to work it, and that after learning how to use it people revert to the old loom. But this is not universally true.

Need for Inquiry into Handicrafts.

In view of the decay of handicrafts, it seems probable that many more people are passing from these occupations into agriculture than are passing from agriculture into factories. If cloths now hand-woven were all made in Indian mills a much smaller number

of operatives would be required. The whole English cotton industry employs only 606,000 persons, and all the cloth needed in India could probably be produced in Indian mills by less than 1,500,000 workers. The growth of mills will not tend, then, within any moderate period, to diversify employment. It seems desirable that an inquiry should be made concerning Indian handicrafts. Every statistician knows how unsatisfactory is a census of occupations when taken as part of a general census. By means of a special industrial census it could be ascertained how many persons are wholly or partially engaged in the various handicrafts, how far such industries are suffering from goods made by modern processes in India or abroad, what measures could be taken to revive them by special instruction, or by the introduction of improved appliances, and what are the earnings and general condition of the artisans. With regard to the proposed adoption of improved hand-looms, there seems need to ascertain what is the best kind for ease and effectiveness of working, and what facilities, if any, could be afforded for the purchase of improved appliances by a system of advances. It may also be worth while to inquire how far electricity can be applied to hand-looms in the manner adopted in some industrial centres in Europe. Although it is probable that the hand-weaving of regular articles of trade on a large scale will ultimately disappear, leaving only a remnant of the original industry for producing special articles for limited markets, in which the power-loom cannot compete, it seems essential that the weavers, for social as much as for economic reasons, should receive practical assistance in tiding over this period of stress.

The Growth of Factory Industries.

The development of factory industries worked by steam power on European lines has been very gradual, and even now none besides cotton and jute employs as many as 20,000 persons. This slow development has been due to various causes—to the use of hand-made articles, to the large imports of cheap cotton goods and metal wares, and to the lack of industrial capital and enterprise, of business managers and skilled operatives. The progress in the chief manufactures, though not remarkable, has been steady, and increasing demands for home and foreign consumption are being met. Small beginnings, offering considerable promise, have been made in a variety of industries throughout the country. In Appendix I. will be found a list of the manufacturing industries of the different provinces. The list may at first sight appear formidable, but many of the industries are very little developed. Bengal and Bombay are by far the most important manufacturing provinces, and they are followed by Madras and the United Provinces. Indian mills are handicapped by the high charges for financing, and the heavy cost of maintenance. Their machinery and stores have to be imported from England, and their coal has usually to be transported over long distances at excessive rates of freight. Labour is as dear as in Europe, because it is unskilled and inefficient. The necessity of European management is another important element of cost. On the other hand, the mills generally have cheaper raw material, produced more or less on the spot, and as against imported goods they enjoy the natural protection conferred by nearness to the consuming markets. Up-country cotton mills especially profit by the proximity of raw cotton on the one hand and a large body of consumers on the other. Climate is yet another element to be considered in a country possessing such variety as India. The humidity of Bombay gives its cotton industry an advantage over that of Calcutta.

Industrial Centres.

As the modern industries have grown up under British influence and guidance even where, as in Bombay, they are now mainly in native hands, it is natural that the great seaports, the provincial capitals, and the railway centres should be the principal seats of manufactures. Industrial cities attract immigrant workers, who leave their women-folk behind; hence a large proportion of "foreign-born" men and a low proportion of females furnish a rough test of the industrial importance of a city. The following Table illustrates the importance and progress of the chief manufacturing cities:—

	Population, 1901.	Increase per cent. between 1872 and 1901.	Proportion of foreign-born per 1,000.	Proportion of females per 1,000 males.
{ Calcutta	848,000	34	657	507
{ Howrah......	158,000	87	659	577
Bombay	776,000	20	766	617
Madras	509,000	28	315	984
Rangoon	235,000	138	680	419
Delhi	209,000	35	284	817
Cawnpore	197,000	61	381	772
Ahmedabad	186,000	55	290	910
Amritsar	162,000	20	264	743

Calcutta has become the centre of a vast industrial area, and the banks of the Hooghly are studded with tall chimneys. In the suburb of Howrah about 10 per cent. of the people depend on jute mills and presses, and over five per cent. on machinery and engineering workshops. In Bombay and Ahmedabad cotton mills support about 15 per cent. of the population, while Bombay, whose inhabitants have declined greatly in recent years owing to plague, has also many other industries. The rice mills of Rangoon give support to 11 per cent. of its population. The importance of Cawnpore as a railway junction and its production of large quantities of stores for Government have made it a great industrial centre.

Capital and Enterprise.

Before dealing specifically with the chief factory industries it is well to consider the general conditions that govern the more advanced manufactures. It has been said over and over again that India lacks industrial capital because the natives hoard their money instead of investing it in banks and joint stock companies, and because British capital is little attracted by Indian investments. It is unfortunately true that the traditional mistrust of exhibiting material wealth, a feeling inherited from the days of extortionate rulers, still prevents the natives from adopting means of investment that would enormously enlarge their own wealth and that of the country. A long course of education may be necessary before such habits are changed. Those who do not hoard can at present reap much larger profits from ordinary money-lending than from industrial undertakings which may involve considerable risk, and the native is rarely satisfied with the low rate of interest which British capital yields. But though an enormous increase in capital is required before India can be adequately developed, there seems to be no present lack of capital in established industries which have grown up under European supervision, such as cotton, jute, tea, &c. For jute two crores of new capital were forthcoming in the eighteen months to December, 1904. These particular industries, then, obtain capital easily, and rupee investments have been specially marked in cotton and jute. The fund on which industrial enterprises mainly depend for initiation and maintenance is the capital and deposits of the three Presidency banks and eight Indian banks, though the exchange banks also contribute something to the financing of Indian business. This fund has greatly increased in the last ten years, and was recently estimated by Mr. O'Conor to amount to £30,000,000. The comparative shortage of money in any quantity entails high interest (about 8 per cent. as a minimum up-country) even when good security is provided. The Indian banks are generally prosperous and with one exception have paid regular, and mostly high, dividends for several years. Signs are not wanting that capital is now flowing into India more freely. The fixity of exchange has safeguarded gold investments since 1897 and has done away with that uncertainty which so long crippled enterprise. The financial position of the Government is extraordinarily sound. The revenue is large and increasing, the assets greatly exceed the debt liabilities, railways and irrigation works have enlarged prosperity, and property is secure from internal disorders as well as guaranteed against external invasion. The steady repurchase during the last ten years of rupee stock held in England and the fact that natives hold £34,000,000 of Government rupee securities (an increase of 63 per cent. in ten years) are of striking significance. A prominent Calcutta banker said recently that *if India got fair play from England* money would never be difficult to find for any properly managed undertaking.

It is probable that India now needs enterprise more than capital. Ages of repressive conservatism have left their mark on the Indians, who generally lack the self-confidence, individuality, and force of character essential to enterprise, and are easily discouraged by failures. They are timid, and they do not sufficiently advertise and push their wares. In mills owned by natives European managers are generally employed, as native managers lack enterprise and initiative, fear responsibility, and cannot cope with unforeseen difficulties. Indians, therefore, usually follow in the lines traced out by Europeans as regards the advanced industries, and European supervision and control are generally requisite. Again, many educated natives despise industrial and commercial pursuits. Their inability, as a rule, to form joint-stock undertakings with success should also be noted, though in Bombay many companies have been formed. The last Punjab census report dwelt on their incapacity to combine except perhaps when they belong to the

same caste, and this inherent lack of combining power, due to the same spirit of mistrust or exclusiveness, has deterred natives from industrial association in Bengal and Madras. In Bengal they are said to invest willingly in enterprises controlled by Europeans, such as jute mills. In spite of all drawbacks, however, the paid-up capital of joint-stock concerns in India (which are in addition to numerous large joint-stock companies with sterling capital having head offices in England), has increased by 42 per cent. in ten years. Nearly one half their paid-up capital of £26,000,000 at the end of 1903-4 was invested in presses and mills for cotton, jute, &c., while 10 per cent. was in tea, coffee, and other plantations.

The Labour Supply.

At the recent conference of Chambers of Commerce in Calcutta great stress was laid on the industrial difficulties resulting from scarcity of labour, which probably arises from various causes. On the one hand, famine and plague have cut off large numbers of landless labourers, while the increasing demand for labour by railways, irrigation works, mills, mines, plantations, &c., has absorbed an increasing proportion of the labouring class. In Northern India, at any rate, the demand now exceeds the supply, and the normal expansion of existing industries is handicapped, to say nothing of new industries. The immobility of labour is remarkable, though there is some migration from the United Provinces into Bengal, from Bengal into Assam, from Madras into Burma, &c. The migration from country to town is slow and difficult, and hence an unsatisfied demand for labour in the chief industrial centres. A rise in wages does not easily tempt a native to change his occupation or abode. Caste and family considerations bind him to the soil. Content with what suffices for food and raiment, the husbandman does not readily quit the fields for the irksome, regular life of a factory, though his earnings might be greatly increased. At Cawnpore, the supply has fallen off, in spite of a rise in wages, and the incidental advantages of cheap houses, short hours, medical attendance, &c. Increased wages may often mean a less amount of work, for, having a surplus in hand, the operative after working for a few months may take a long rest in his village, where subsistence is very cheap. Increased demand for labour often causes deterioration in quality. The ambition of the natives is usually to get good pay, not to do good work, and they show little growth in skill, though some advance is perceptible in the Bombay cotton mills, where a class of factory operatives is growing up. Many operatives there stay in the mills all their lives, and bring up their children to factory work. India, then, is suffering from a shortage of labourers, and from the fact that the operatives lack energy and skill, and fail to respond to the inducements that higher wages offer in Europe. At a typical Bombay cotton mill that I visited under the skilled guidance of Mr. Engel, the Inspector of Factories, the men earned on the average 5s. a week and the women 1s. 6d. a week. If the wages seem low the standard of work is also low—physique, climate, degree of intelligence and other factors modifying the power of output. The mill operatives are drawn not only from the landless labourers, but also from the poorer ryots and the hand-weavers. Men are often employed on work that women would do in England. They take little interest in their work, and have little ambition to excel, they cannot assume responsibility, and there is much waste. They require also to be humoured in many ways. Different castes have different meal times and the men break off thrice a day to go outside and smoke cigarettes. Their work is irregular and they usually have a month's holiday besides Sundays. Their holidays are partly for religious festivals, partly for work in their villages during seedtime and harvest. Owing to these circumstances about five operatives are required where one would be employed in England, and consequently the cost of labour is at least as great as in England, which shows that Indian labour—once feared by English trade unionists—is not really a source of danger. Factory work is popular in so far as the wages are much above those earned by people of the same class in other pursuits, and the general condition of the workers is prosperous. For housing the cost is about 2s. to 2s. 6d. a month, for clothing about 2s. a year, while subsistence is obtainable for a penny a day. The scarcity of labour has forced up wages, and the rise seems likely to be permanent. In the jute industry mill extensions are being deprecated on the ground of shortage of labour, while plague has affected the supply in Bombay and the United Provinces. In Madras the supply seems ample, but there is a chronic unsatisfied demand in the Assam tea-gardens.

Factory Legislation.

The Indian Factory Act of 1881, as amended in 1891, fixed the minimum age for child labour at nine years, and the hours of work at seven, while women's hours were restricted to eleven with intervals of 1½ hours. The hours of adult males, as in England, are nominally unrestricted, but hours of rest and holidays are regulated for all workers. Ample holidays are taken, especially in hot weather, and Sunday closing is compulsory with some exceptions. In 1902 the number of factories liable to inspection was 1,389, mostly in Bengal and Bombay. In 60 of these, chiefly jute presses and printing presses, steam power was not used. Cotton mills and presses constituted about 60 per cent. of all the factories worked by steam. Rules regarding ventilation, sanitation, water supply, the fencing of machinery, &c., are well observed, while the number of accidents is not large. Many millowners go far beyond the requirements of the Act, everything being done to make factory life attractive to the somewhat unwilling operatives.

The Supply of Power.

Only in recent years have the Indian coal-fields yielded sufficient to make India self-supporting. The railways consume 30 per cent. of the present output of 7,500,000 tons, while mills, steamers, &c., use the remainder. The increased proportion of coal consumed otherwise than by railways points to some growth in industry, but in 1903 production was checked owing to the supply exceeding the demand. Electric power is now being employed, and there has recently been a brisk demand for installations in the Bombay cotton mills. Calcutta and Bombay have electric power stations, and a large scheme is on foot for supplying it to the Punjab. The transmission of electric power from the Cauvery Falls to the Kolar gold-fields for various mining and metallurgical works is an admirable illustration of what may be done elsewhere.

The Principal Manufacturing Industries.

The various factory industries may be classified as follows :—

(1.) *Manufactures proper*, conducted for the most part by means of steam-power on European lines. They include the spinning and weaving of cotton, jute, wool, and silk, dyeing, paper-making, coir manufactures, leather manufactures, brewing and distilling, rope-making, flour milling, oil milling, sugar refining, printing, shipbuilding, engineering, iron, steel, and brass foundries, electricity supply, gas supply, manufacture of ice, aërated waters, perfumery, &c.

(2.) *Manipulation or Preparation of Agricultural, Forest, or Animal Produce.*—This head comprises tea and coffee production, ginning, cleaning, and pressing of cotton, jute pressing, indigo manufacture, husking and cleaning of rice, tobacco manufacture, silk filatures, opium manufacture, lac manufacture, saw mills, preparation of coir and copra, tanning and dressing of hides and skins, fish-curing, bone-crushing, &c.

(3.) *Utilisation of Minerals.*—Refining of petroleum and manufacture of oil products, salt and saltpetre refining, chemical and alkali works, lime and cement works, making of paints and colours, brick and tile-making, pottery, jewellery, copper, brass, and tin-smiths' work.

The above classification aims at being logical, but no division can be strictly logical, and for practical convenience I shall single out only a few important manufactures for special treatment. In Appendix II. will be found a list of the chief industries with the numbers employed according to the volume of Financial and Commercial Statistics, issued in 1904, and the census returns for 1901. The former are admittedly incomplete, while, owing to difficulties of enumeration, the census figures can only be regarded as approximate.

The Cotton Industry.

Considering the wide-spread production of raw cotton, it is not unnatural that cotton manufactures have long flourished in India, and that Indian cotton goods were famous in England before the Lancashire cotton industry began. Improvements in machinery and the use of steam power in Europe destroyed India's former supremacy in textiles, but being now equipped with the latest appliances she is endeavouring to win back her home market for yarn and piece goods. Cotton being one of her staple crops, India can save the freight, commissions, &c., that England has to pay for importing raw material and re-exporting this material in a finished form. But besides cheap cotton, the industry needs cheap fuel, machinery, and stores, an adequate supply of skilled labour, cheap land and buildings, capital at low interest, and large and stable markets.

The Supply of Raw Cotton.

The cotton area, which exceeded 17½ million acres in 1890-1, declined for some years owing to bad seasons, but has increased to about 19 million acres in 1904-5, as against 18 million in 1903-4. The annual yield of fibre probably ranges from about 3 to 3½ million bales (of 400 lb.), and it is roughly estimated that about 40 per cent. is exported, 48 per cent. used in the mills, and 12 per cent. consumed locally. The crop, then, is a most important and valuable one. England, once the chief buyer of Indian cotton, cannot now spin the short-stapled fibre to advantage, and the principal purchasers to-day are Japan—by far the largest—and the countries of Continental Europe. For a century endeavours have been made to improve the quality of Indian cotton, and owing to recent shortages of American cotton and high prices, these efforts are being renewed. The agricultural departments aim at improving the out-turn by improved cultivation, by the introduction of new varieties, and by the selection and hybridization of indigenous plants, which are expected to be more fruitful than the growth of exotic varieties. The latter, however, are being tried in Sind on irrigated soil. So far as the cotton fibre has deteriorated, it is probably due to continued cultivation of the same strains of seed, to carelessness about seed selection and cultivation, and to impoverished soil. The ginning mills have supplied cultivators with very mixed seed, which, when grown regardless of the character of the soil, has yielded inferior fibre. But there are other reasons. Inferior varieties are grown extensively because they can be produced on soils unsuited to finer varieties. Moreover, the coarse, short-stapled cottons are hardier, are less liable to injury from insects and bad seasons, can be planted later, mature earlier, and give a larger yield, which compensates for the lower prices they fetch. There is always a crop of such cotton, and it is in constant demand both for home consumption and for export. The cultivator who wants not a long-stapled cotton but a paying crop, has deliberately substituted the inferior variety, and he cannot be blamed for thinking of his own needs rather than Lancashire's. He will not grow finer cotton to meet an intermittent demand at very fluctuating prices. The largest and most reliable purchasers of Indian cotton—the Indian mills and the Japanese—do not require a long-stapled cotton for the production of their coarse yarns.

The ginning, cleaning, and pressing of cotton by steam have increased, and 900 factories, mostly native owned, employ 75,000 people in this work. More than one-half are in the great cotton areas of Bombay and Berar. Complaints are often made of the increasing adulteration of cotton, and the re-enactment of the Cotton Frauds Act has been suggested in order to keep bad cotton from being introduced into districts that grow good cotton. But the Act of 1863 was repealed in 1882 on the ground that it was not only ineffective, but often punished the wrong persons, while it also did harm to the industry.

The Growth of the Mills.

Considering that cotton mills have existed in India for 50 years their progress has not been extraordinary, though, as the following figures show, they have steadily advanced in the last 20 years.

	1883-4	1893-4	1903-4
Mills	74	137	204
Spindles (000 s)	1,895	3,540	5,213
Looms (000 s)	16	29	46
Persons employed (000 s)	62	131	186

It will be noticed that the increase in spindles was roughly the same in each decennium, though looms increased faster in the second. The increases in the 20 years were 176 per cent. in spindles and 186 per cent. in looms. In 1903-4 the mills comprised 113 exclusively spinning, 5 exclusively weaving, and 86 both spinning and weaving. The *employés* were 64 per cent. men, 20 per cent. women, and 16 per cent. children. As compared with English mills the percentage of men employed is very high. All but 33 of the mills are owned by joint-stock companies, and the paid-up capital and debentures of the mills are estimated at £10,500,000, by far the greater part being rupee capital, the investments of which are increasing. Indeed, native capital flows into cotton much more freely than into any other manufacturing enterprises. The amount of capital invested in weaving is considerably less than in spinning.

The most numerous mill owners in Bombay and Ahmedabad are the Bhattias, who own more than half the mills, the rest being owned by Englishmen, Parsis, Jews, and Mohammedans. Up-country mills are generally native-owned, and the important Cawnpore mills, though undertaken by Europeans, have been financed by natives.

In recent years the cotton industry has suffered great vicissitudes, especially at its head-quarters, Bombay City. Apart from recurring difficulties due to financial short-comings, and to faults in management and equipment, there has been a succession of special troubles. The outbreak of plague drove the operatives from the city in thousands, and the high plague mortality has made labour scarce; in 1896-7 and again in 1900-1 drought curtailed enormously the supplies of raw cotton, while famine reduced the purchasing power of home consumers; and political disturbances in China with fluctuating exchanges injured business with that great consuming country. In consequence of these troubles many mills have gone into liquidation, reduced their capital, or undergone reconstruction. At the same time the industry has expanded by the erection of new mills, and the quality of the products has improved. With cheaper raw material, a steadier demand for yarn in China, and a well-sustained home demand, the mills are once again in full operation. The more extensive weaving of cloth is a source of strength to the yarn market. Finer yarns are required for cloth made in the mills, and it is better to produce these than the coarser yarns exported to the fluctuating China market.

About 70 per cent. of the mills and the spindles and 76 per cent. of the looms are in Bombay Presidency, and the majority of these are in Bombay City, but Ahmedabad is gaining on the capital, because, being in the midst of a great cotton-growing region, it obtains its raw cotton more cheaply. In ten years Ahmedabad has increased its spindles by 126 per cent. and its looms by 76 per cent., and it shows great promise of further development. After these two cities, Sholapur is the chief spinning centre and Broach the principal weaving centre in the Presidency. Nagpur (Central Provinces) possesses 1,580 looms, while Cawnpore, with 3,215, and Madras, with 1,747 looms, monopolise the power-loom weaving in their respective provinces. In Appendix III. is a Table showing the relative importance of the different provinces in the cotton industry. During the last ten years the growth in spindles and looms has been proportionately greatest in India outside the Bombay Presidency. These up-country mills supply yarn to local weavers, and sometimes cloth for local consumption. Many of the Bombay mills have dye-works, and a few do bleaching. These processes require water, the high charges for which by the Bombay Corporation have been a subject of complaint. The growth in the export of cotton goods, as shown below, furnishes evidence of the development of the industry.

	1883-4	1893-4.	1903-4.
Cotton twist and yarn—million lb.	50	134	252
Cotton piecegoods—million yards	56	73	76

Cost of Production.

We have dealt generally with the question of cost of production in Indian mills, but the cost of cotton production requires special notice. The cost of sites is not serious in Bombay, and is negligible up country, but the cost of buildings and equipment in India, as compared with Lancashire, is 2½ times greater. Indian mills have up-to-date English textile machinery, on which in the last three years alone over £2,600,000 has been expended. Wages amount to 8 to 10 per cent. of the value of yarn, and 20 per cent. of the value of cloth. As already shown, the cost of labour is as great as in England, for the operatives are more numerous though less well paid, require more space, are unskilful, and make much waste. Mill stores are dearer than in England by the cost of freight and 10 per cent. commission to agents. Country coal is fairly good, but Bombay is far from the mines and transport is very dear, so that coal is 50 per cent. dearer than in Lancashire. Capital, again, requires 6 to 7 per cent. for interest as against 3½ to 4 per cent. in England. In recent years there has been warm discussion about the commissions paid to agents for managing the mills, purchasing all requisites, selling yarn, &c. A system grew up of remunerating managing agents by a commission of ¼ anna per lb. on every pound of yarn spun without reference to profit, and it had a certain advantage in earlier days by tempting unenterprising capitalists into the industry, but it was also an incentive to over-production involving loss, as the agents were anxious to produce as many pounds as possible regardless of the selling price. The ¼ anna system is still retained in some mills, but in others the agents have accepted the much fairer basis of 10 per cent. commission on profits.

The Cotton Duties.

Complaints are still occasionally heard about the cotton excise duties, and some mill-owners contend that these duties enable the hand-made cloths, which are not subject to them, to compete successfully with the factory cloths. Others, however, admit that a duty so small as 3½ per cent. *ad valorem* can

give but slight appreciable advantage to the hand-looms, and the position of the hand-weavers, as we have seen, is far from flourishing. Moreover, the taxation of hand-made cloths could only be effected by the taxation of the Indian and English yarns that hand-weavers most widely use, and probably no mill-owner would welcome such an innovation. It is felt in India that if any fundamental fiscal changes take place in England India can legitimately claim a free hand in modifying its tariffs. One mill-owner even favours a 10 per cent. import duty, with a corresponding excise duty, on the ground that consumers would be driven by the dearness of imported cotton goods to buy the cheaper Indian cloths. Needless to say, a 10 per cent. import duty without the excise would be infinitely more acceptable.

Production of Cotton Yarn.

The chief business of the cotton mills is the production of yarn for export, for use in power-loom weaving, and for consumption by hand-weavers. The following table shows the production during 1903-4 in British India, distinguishing higher from lower counts (in millions of lb.) :—

	Counts 1 to 20.	Counts over 20.	Total.	Per-centage of higher counts to total production.
Bombay	327·4	87·5	414·9	21
Central Provinces and Berar	19·9	4·7	24·6	19
Madras	23·8	4·9	28·7	17
Bengal	43·8	2·7	46·5	6
United Provinces and Ajmer	29·5	0·4	29·9	1
Punjab	11·6	0·04	11·6	0·3
Total	456·0	100·2	556·2	18

Native States in 1903-4 produced 22,568,000 lb. of which 18 per cent. consisted of counts above 20 s. Yarns of the higher counts have increased from about 14 per cent. of the total Indian yarn production in 1897-8 to 18 per cent. in 1903-4, and this growth was specially marked in the last year, which showed an increase from 12·5 to 16·5 million lb. in counts 31 to 40 alone above 1902-3, while the lowest counts declined. In the higher counts Ahmedabad has increased faster than Bombay City, while Madras, which spins largely for the local market, has advanced in counts 21 to 30. The predominance of Bombay, the Central Provinces, and Madras in counts above 20 is remarkable, and their output is increasing.

In yarn production the most important and fluctuating element is the cost of raw cotton. The coarser Indian cotton is specially adapted for spinning yarns up to 20 s, though Hubli, Broach, and Dhollera can be fairly well spun up to 42 s. Average cotton can be spun up to 32 s, and Bombay mills have practically ousted imported yarns up to 24 s. The lack of skill of the operatives tells most in spinning higher counts, as they make a great deal of wastage, which has to be worked up again.

The following figures show the competition in 1903-4 between Indian and imported yarns, which are mainly coloured (in millions of lb.) :—

	Indian yarn.	Imported yarn.
Counts 1 to 20 ...	474·5	2·5
„ 21 to 30 ..	86·8	4·0
„ 31 to 40 ..	16·5	14·5
„ over 40 ..	0·9	4·8
Total	578·7	25·8

To the imported yarn must be added 2·2 million lb. of unspecified counts. It is noteworthy that the Indian mills now produce more of counts 31 to 40 than are imported, though these form the bulk of the English yarns. It is not surprising, therefore, to find that yarn imports have declined from an average of 48·4 million lb. in the five years ended 1898-9 to 35·5 million lb. in the quinquennium to 1903-4.

The question of the disposal of the imported and Indian yarns is important in its bearing on the position of hand-loom weavers, who use most of the imported yarn, though a good deal appears to be used by the mills, especially up-country. The following figures are for 1903-4 :—

	Millions of lb.
Imports of foreign yarn (deducting re-exports)	27
Production of Indian mills	579
Total amount of yarn available..	606
Less exports to China, &c..............	252
Balance for Indian power and hand looms	354

The exact proportion in which this balance is distributed between the power and hand looms cannot be ascertained, but the latter are supposed to absorb 35 per cent. of the yarn

produced in the mills (or 203 million lb. in 1903-4), together with most of the imported yarn. Probably the hand-looms consume 50 per cent. more yarn than the mills in addition to the hand-spun yarn made locally. These figures, however, can only be taken as approximate.

About 94 per cent. of the yarn exports go to China, which has a large demand for counts up to 20 s, while dealings with Persia and Turkey have increased. In China, India's chief competitor is Japan, but in recent years India's spindles have increased faster than Japan's. As Japan depends mainly on Indian raw cotton, there is great scope for the extension of Indian yarn production by the working up of the cotton now sent to Japan.

THE PRODUCTION OF COTTON CLOTH.

In weaving, the Indian mills have to withstand the competition of (1) the hand-weavers, who especially compete in saris; (2) the Lancashire mills, which compete chiefly in the coarser grey goods, inasmuch as India does not largely produce piece-goods like the finer unbleached or the white and coloured goods that are imported; (3) the Continental mills, whose contributions, mainly coarse and inferior goods, are small in proportion to the total import of cotton manufactures, though not inconsiderable in proportion to the total Indian mill output. Indian mills appear to be making headway against all three competitors. Some mill-owners, however, fear the competition of hand-woven cloth, the home consumption of which has been recently estimated at thrice that of power-loom cloth. This is not improbable, if it be remembered that some of the latter is exported. The average production of a power-loom is estimated at 12 lb. of cloth a day, as against 2 lb. from a hand-loom, though the latter cloth is said to last thrice as long, which partly explains the preference for hand-woven cloths by certain classes of the people. We shall deal directly with foreign competition in Indian manufactures.

A great expansion in weaving has occurred during the last two years, a few Bombay mills with modern plant having made remarkable progress. An addition of 5,000 looms is expected in 1905. Mill-owners have discovered that cloth production for the long-neglected home market is less risky and more profitable than yarn production for China, especially when yarn prices are low and those of raw cotton high. The absorption of yarn by the mills not only relieves the China yarn market, but the output of Indian cloth carries the process of manufacture a stage further and enables India to compete against the coarser imported cloths. An enlarged home and foreign demand in 1903-4 occasioned an advance in prices though production was much greater.

Indian mills produce mainly grey goods, of which the output in 1903-4 was as follows (in million of lb.):—

Shirtings and longcloths	39·2
Dhotis	26·7
T-cloths, domestics, and sheetings..	19·1
Chadars	14·1
Other sorts	12·4
	111·5

The quality of the output has improved, and recently the production of longcloths has greatly advanced. Grey goods represent 81 per cent. of the cloth production, but more rapid progress has taken place recently in white, fancy, and coloured goods, which, however, are not yet largely produced owing to the difficulties of bleaching and printing. The proportion of woven goods other than grey is highest in Madras, where excellent cloth is made, including khaki for native troops. There has also been progress in hosiery, which is made only in Bombay, being produced in the cloth mills or in small separate factories. Weaving is concentrated in Bombay to an even greater extent than spinning, the Presidency mills turning out 86 per cent. of the cloth woven in British Indian mills. The expansion at Ahmedabad from 19·1 to 28·7 million pounds in the two years to 1903-4 is remarkable. This city weaves a limited quantity of high-class cloths, such as dhotis, from fine English yarns. Lower cost of production and a favourable situation enable Ahmedabad to compete keenly with Bombay City in the supply of cloth to Northern India.

The following figures (in millions of lb.) show that the production of woven goods in British India has increased 50 per cent. in the last six years:—

	Grey.	Other kinds.	Total.
1897-8......	80·0	8·0	88·0
1903-4......	105·8	26·2	132·0

In addition, the production of Native States has grown from 3·3 to 6·2 million lb., a greater proportionate increase than in British Indian mills. But the total production of Indian cloth is only equal to about 25 per cent. of the imported cotton manufactures.

The production of piece-goods in the five years to 1903-4 averaged 513 million

yards, while the exports of piece-goods averaged 71 million yards, some portion of which, however, consisted of hand-made cloths. In 1903-4 there was an increase in cloth exports, after a considerable period of inelastic trade. A considerable part of the exports consists of dyed or printed goods from Madras, which go increasingly to the Straits, Ceylon, Aden, &c., while grey goods are sent chiefly from Bombay to Aden, Abyssinia, and East Africa. Cloth exports to China have declined, but there is a growing market in the Levant. On the whole, the outlook for Indian cloth production is excellent, both in foreign markets and in India, where the fashion of wearing more clothes is increasing with the growth of prosperity.

FOREIGN COMPETITION IN COTTON GOODS.

Cotton manufactures constitute 34 per cent. of all Indian imports. The imports of cotton piece-goods taking five-year averages, have been as follows (in millions of yards):—

	1889-90 to 1893-4.	1894-5 to 1898-9.	1899-00 to 1903-4.
Grey (unbleached)	1,223·5	1,209·8	1,204·5
White (bleached)	368·6	418·6	469·7
Coloured, Printed, and Dyed	374·2	351·5	430·6
Percentage of grey goods to total imports	62	61	57

There has been a decline, though not a serious one, in the grey goods with which Indian mills compete most keenly. England supplies 99 per cent. of all grey goods. The import of white goods has decidedly increased, probably because they are made of superior material. Over 98 per cent. are imported from England. Coloured goods also come from England to the extent of 96 per cent., the rest coming chiefly from Continental Europe. About 10 per cent. of the imports of coloured goods are re-exported. Foreign competition with England is most apparent in cotton hosiery and miscellaneous cotton goods, and the slackness of England and the activity of the Continent are hard to explain. British piece-goods are found all over India, and are especially preferred by the middle-class natives, because they are finer and cheaper, even if less durable than native cloths. The late Sir George Cotton, who had wide experience of India and Lancashire, was of opinion that India could never compete in finer goods, because the English mills are better equipped for fine counts, while British labour is more skilful and efficient. The sizing percentages of English goods cannot be approached by the Indian mills, which use much less size in the weaving process, though some is added later. England, too, has other advantages in cost of production. To compete with English mills India would have to import fine cottons and many other requisites, and only one-sixth to one-fourth of the value of the product would really represent India's share in wages and profits. To manufacture even the grey cloth now imported India would have to double her existing mills. Probably, then, India will long continue to buy the fine and cheap goods of Lancashire.

JUTE MANUFACTURES.

We turn from cotton to a somewhat smaller though an even more successful industry, viz., the manufacture of jute. Power-looms for this purpose were first erected in 1857, but for a long period jute was largely produced by hand-looms. This handicraft for making sacking and ropes has now decayed, and the industry is mainly a factory one.

Calcutta is the great centre of jute production, and except one mill at Cawnpore and another in the Vizagapatam district (Madras), all the mills are in Bengal, and most of them in the vicinity of Calcutta. All but four of the mills are worked by joint-stock companies. The growth of the industry in the last 20 years is shown in the following Table:—

	1883-4.	1893-4.	1903-4.
Mills	23	27	38
Nominal capital	£1,357,000 Rs.115 lakhs.	£1,160,000 Rs 231 lakhs.	£2,263,000 Rs.403 lakhs.
Spindles	112,650	191,228	376 718
Looms	6,139	9,180	18,406
Employés	47,868	68,291	123,869

It will be seen that while the industry increased about 50 per cent. in the first decennium it advanced 100 per cent. in the second. Sterling capital has increased, with fluctuations, by 67 per cent., while rupee capital has steadily grown by 250 per cent. in the 20 years, and now exceeds the sterling capital. As in cotton, so in jute, the native capitalist is tending to subscribe the new investments of capital. Of the *employés*, 81,700 are men, 21,140 women, and 21,000 children. The jute workers are well paid and live in healthy surroundings, and as their wages afford a large margin beyond the cost of subsistence they take long holidays—two months or more. Jute has made thousands of workers prosperous, and to the high wages of jute opera-

tives has been partly ascribed the want of progress in cotton and other mill industries in Bengal. On January 1st, 1905, the jute looms numbered 21,318, and about 2,000 more are to be put in this year. Some fear that the mills are being too rapidly extended. The supply of labour is short, while high pay makes the operatives independent. Competition for labour due to extensions raises wages, while a greater demand for raw material enhances the cost at the same time that a larger output of goods diminishes their price. But so long as a large quantity of raw jute is required abroad and the foreign demand for bags and cloth is unabated, which seems likely for a long time, over-production need hardly be feared, though extensions should be gradual if the present high rate of profit is to be maintained.

Calcutta is now the centre of the jute manufacture of the world, and naturally so as it is near the area which has a practical monopoly of the production of raw jute. Calcutta is favoured not only by its proximity to the sources of the raw material, but by ample supplies of coal from the adjacent Bengal mines. One freight only has to be paid to foreign markets as compared with two by Dundee, and there is a constant demand for hessians and gunnies, to which the Calcutta mill owners restrict their energies. The relative importance of Dundee has greatly diminished, her share of the Indian crop being now only about 20 per cent., instead of, as formerly, almost the whole crop. The Calcutta mills are said to be better equipped than most of the Dundee mills, for owing to recent extensions, their machinery is more up-to-date, and they gain by combining weaving and spinning. Having cut Dundee out of most of her old markets in heavy goods and common hessian cloth, Calcutta gradually ceases to compete with that city, which now produces mainly special kinds of yarn and piece goods. In Europe jute is largely used for making carpets, curtains, and shirtings, and for mixing with silk and wool. Apart from England India's chief competitors in jute manufactures are Germany, France, Austria-Hungary, and Italy, which secure their home industries in jute by protective tariffs. In Germany there is a strong jute trust.

Although the demands for raw jute for manufacture and for export are rapidly increasing, the area under jute has expanded but little in recent years. About 2,850,000 acres are under the crop, and the yield has varied in the ten years to 1902-3 from about 5,000,000 to 6,500,000 bales (of 400 lb.). Crop variations render the jute trade very speculative. On the whole, there has been an upward tendency in raw jute prices, amounting to about 25 per cent. in the last 20 years. The estimated total out-turn for 1903-4, viz., 7,462,000 bales, was roughly distributed as follows: exports 3,788,000, mill consumption 3,144,000, local consumption 500,000, and stock 30,000 bales. An increase in the jute area is a matter of considerable importance, for unless India increases her acreage there may be a shortage of supply in the world market that will either stimulate cultivation elsewhere or the use of substitutes. The pressing of raw jute, a separate industry, occupies 155 presses, and employs 21,000 persons.

A recent official report on the alleged deterioration of jute suggests that the plant should be cut for fibre before it is dead ripe, and that liberal cultivation, and probably also rotation of crops, ensure a better out-turn of fibre. Adequate manuring and the use of selected seed have been recommended. There is no evidence of any deterioration of the plant, the best kinds of which yield excellent crops and excellent fibre, if the latter be properly extracted. The lower average quality of jute in recent years is ascribed to the bringing of inferior fibre to market to meet the enlarged demands, whereas formerly only the best jute found a sale. Middlemen are said to resort to fraudulent watering which gives a fictitious increase in weight, and, at the same time, induces heating and discoloration.

About one half of the jute crop is worked up in Indian mills, and a large portion of their production is used in the country, partly for export in the form of coverings for grain, seeds, cotton, &c. Indian jute bags are sent all over the world, but jute cloth goes mainly to the United States and Argentina. For the last two years cloth exports have been advancing to the detriment of sacking. More cloth is being shipped direct to Argentina, thus saving the extra cost of freight *viâ* Liverpool. The value of the jute manufactures exported in 1903-4 was £6,300,000. The growth in the export trade has been as follows:—

	1883-4.	1893-4.	1903-4.
Jute bags (No. in millions)	64	131	206
Jute cloth (million yards)	7	61	552

Jute coverings are mere coarse envelopes, dispensed with after use, and are used on account of their cheapness rather than any

intrinsic excellence. Their cost is rising with the rise in the cost of raw material, and a point may be reached where it would pay to use substitutes, at least in some markets. Hence proposals that have been made to impose an export duty on jute must be received with caution.

WOOLLEN MANUFACTURES.

The woollen mills during the last 10 years have increased their output from 1,953,000 to 2,977,000 lb., the number of spindles having grown in that period from 17,320 to 25,216, and the looms from 526 to 678. The production is not very great, nor can any important expansion be anticipated. The climate precludes any wide demand for woollens. Cotton goods are cheaper, and imported woollens are frequently preferred to home-made articles because taste or fashion or cheapness of production commend them to European and other consumers in India. The imports, which are most considerable in piece goods and shawls, comprise, besides the finer kinds of cloths, in which India cannot easily compete, various mixed and shoddy goods requiring elaborate machinery. These foreign woollens are largely sent by the Germans, who are said to be doing much business at a loss in order to capture the market. The shawls which they have been selling freely are of inferior size, weight, and quality.

The Indian woollen mills are six in number—one at Cawnpore, one at Dhariwal (Punjab), three in Bombay, and one at Bangalore. Only the first two are of any importance. They represent a capital of £213,000, or about 70 per cent. of the total capital invested in the industry, and they pay good dividends. They weave cloth for the army and police, and articles of superior quality generally, including broadcloth, tweeds, serges, shawls, flannels, hosiery, blankets, rugs, braid, &c., while the Bombay mills make blankets, socks, caps, &c. For higher-class woollens Australian wool is used, either pure or mixed with Indian wool, which is hard, dry, uneven, hairy, and short-stapled. There are many hand-loom factories for carpets, rugs, and blankets, the blankets being widely used, not only for bedding, but for protection against rain and cold in the open. The natives, however, often prefer stuffed cotton cloths as being warmer than woollens. The coarsely-woven and felted goods, widely produced at a very low price locally, are not likely to suffer from mill competition. The Punjab and Kashmir produce highly-finished goods made by hand, but the industry on a small scale tends to disappear. Change of fashion and European competition have reduced the demand for fine Indian shawls. The weaving of woollen pile carpets is widespread, but the inferior Indian wool will not take the finer shades of colour. The price of the carpets depends partly on quality and partly on the number of threads to the inch. The carpet factories of Amritsar are flourishing, and many weavers thrown out of the shawl industry have taken to carpet-weaving. There is a large and increasing production of carpets at Mirzapur, but the quality is said to have declined owing to a fall in the prices obtainable in England. The jail carpets of Agra are well known. The Madras carpet industry has fallen off in the centres of Ellore and Masulipatam. There are several carpet factories in Bombay city and around Ahmedabad. The exports of Indian carpets—the only woollen exports worth recording—are inelastic; they are bought chiefly by England and the United States. On the other hand, India has an import trade in carpets and rugs, mainly from England.

SILK MANUFACTURES.

Formerly Indian silks were famous in Europe, but, while other countries have improved their processes of production, Indian manufactures have suffered from defects in the methods of rearing, reeling, and weaving. Change of fashion, the use of cotton instead of silk goods, and, above all, the competition of France and Italy, China and Japan, have caused Indian silks to be supplanted even in India itself. Bengal still produces most raw silk, and has many silk filatures, but Bombay, which has the two most important steam silk mills, largely uses raw silk brought from China in the returning opium vessels. These factories send considerable quantities of silk goods, chiefly handkerchiefs and scarves, to Burma, which also buys silks from a mill near Calcutta. The Bombay mills supply a local demand of the middle and poorer classes for saris, &c. They make forward contracts for the supply of certain goods to large firms, who distribute them in India and Burma. The steam silk mills seem unlikely to extend appreciably so long as they weave cheap fabrics from waste silk, though they may cut out the hand-weavers in cheap saris and cholis. Scattered over India, but principally in Bengal, are about thirty hand-loom silk factories. Some of the Bengal factories use

wild silk (corah and tasar), and they are owned and managed by natives who employ no European machinery. In Bengal, promising experiments are in progress for improving silk rearing, and demands for raw silk are said to have increased owing to developments in the local industry. Silk weaving is also said to be progressing in Burma and the Punjab, the provinces that use most silk goods. At Amritsar pure and mixed silk goods are made with raw silk that comes from the Far East *viâ* Bombay. This imported silk is said to take colour better, and to be more easily worked than Indian silk. Silk goods are also produced by hand in the Central Provinces, United Provinces, and Bombay. The fine silk brocades of Surat and Ahmedabad are hand-made. Madras exports silk goods to countries whither emigrants have gone—Burma, the Straits, Mauritius, Natal, &c.

In the last few years an important development in silk production has taken place in Kashmir under State control. It now has ten first class filatures for reeling and storing cocoons. Silkworms' eggs are brought from Europe. Including rearers and operatives, there are 50,000 persons employed in this industry, which produces satisfactory silk and realises good profits. Experiments in weaving are in progress.

Indian exports of silk goods have declined, and are now only one-third of what they were ten years ago, while imports of silk goods have developed.

TANNING AND LEATHER MANUFACTURES.

The tanning and curing of raw hides and skins form an extensive industry, while leather manufactures are also of great importance. The census shows 9,000 workers in large tanneries and factories, 253,000 tanners, curriers, &c., 853,000 shoemakers, and 100,000 makers of water and other bags. For 30 years exports of hides and skins have expanded—the enormous supplies from Bengal and some other provinces being exported raw, while Madras draws supplies from all over India, and sends most of them abroad partially tanned or dressed to be retanned and curried in the country of destination. In 1903-4 Madras exported 90 per cent. of the tanned hides sent abroad, and 77 per cent. of the tanned skins. Owing to competition the prices of raw hides and skins have tended upwards for years to the great gain of India. The best raw materials are exported raw, but all rejections are tanned, so that the reputation of Madras tannages suffers. The collection of hides and skins and tanning work fall to the lowest classes, who require high wages to draw them from agricultural work. Any important reforms must involve the training of these labourers, but Mr. Chatterton—whose authority I am largely following in this section—says that some reforms have been effected, and sufficient skilled labour is probably forthcoming for more.

Indian hides are usually small and inferior owing to the poorness of the cattle, wear and tear of draft work, and injury by branding, which greatly reduces the value of the hides. Hides mostly come from animals that have died of disease, old age, or injury, and quality varies with seasons, being worst during famines, when supplies are most abundant. The local demand for hides in India is enormous. The skins, unlike the hides, are mostly those of slaughtered animals, especially goats and sheep, goat-skins being superior. They compare favourably with those from other parts of the world. Skins are chiefly tanned in Madras, the centre of the Indian tanning industry, and their price has risen in American and European markets. Most of the dried skins exported since 1899 have gone to America for the use of chrome tanners of glacé kid, and large quantities of pickled skins go to the same market. A bad defect of Madras tanning is the over-oiling of skins in order to get more profit. England buys nearly all the tanned skins. Madras slaughter-house skins, on account of careful tanning and excellent grain, take the first place in the London market, and are used for highly-finished bookbinding leathers. Madras tanning has developed, owing to the cheapness and good quality of the raw materials used in the tanning pits, and the tanner knows his business. Losses, however, have ruined many small tanneries, and large ones, properly managed, now do most of the work. Of late, Europeans, owing to speculation and keen competition, have tended to withdraw from the Madras skin business, which is now largely financed by wealthy natives. Hides are tanned but not curried, skins tanned but not dressed. India itself offers but a small market for high-class leather or dressed skins. Most of the lightly tanned hides exported are re-tanned for conversion into upper leathers. The hides being inferior can not be satisfactory even if tanned perfectly, and it is doubtful if Madras hide tanning can be improved considering the bad raw material,

though perhaps the up-country tannages can. The best Madras skins are good enough for all practical purposes, and probably no changes in tanning would yield better results. But the character of the work might be levelled up, and skins might be better graded. The industry requires more capital. Bombay and Cawnpore produce the best leather possible from the raw material available but the supply usually exceeds the demand, and the success of this industry is only assured by large Government orders. The chief tanneries in the United Provinces employ 4,915 persons, and the best leather they make would be hard to beat. In Bombay city there are eight to ten large tanneries, at Ahmedabad four large and many small ones, at Surat two large ones, and at Belgaum one large tannery, which exports to London. In Calcutta there are seventeen tanneries (seven of them owned by Europeans). The local native tanner is losing his occupation through the competition of these large up-to-date tanneries, and through the high prices of raw hides and skins.

Cawnpore has been a centre of leather manufactures for more than a century. For 35 years Government has had a harness factory there, and the Army Boot and Equipment Factory of Messrs. Cooper, Allen and Co. supplies boots to the British army in India, to most of the native troops, volunteers, and to Government departments. Their factory employs 3,685 persons. This city stands first in boots, shoes, harness, saddlery, trunks, and other leather goods in European style, and articles supplied to troops in the South African war were highly commended by Lord Roberts. The village saddlers and shoemakers in the United Provinces get better and cheaper leather from the large tanneries than they could get from the native tanner, and they have not suffered from foreign competition. In Bombay city many articles of good workmanship are produced. The Western India Army Boot and Equipment Factory executes large Government contracts, while other factories do work for the police and railway servants. These factories turn out goods of a kind formerly imported, and they appear to be capable of production for export. Sholapur produces bags, trunks, &c. Most footwear is made in the bazaars, and shoes of European pattern are increasingly worn. The local leather worker holds his own in spite of the competition of shoes from the great leather manufacturing centres. In Bengal foreign leather is much used by town shoemakers, and the inferior indigenous leather manufactures are being replaced by cheaper and better imported goods, except as regards water bags and other rough articles. In Madras presidency the only large factory is the Government harness and saddlery workshop, which also produces equipment, accoutrements, &c., for troops, the leather being brought from Sion (Bombay). There is a boot and shoe factory at Coimbatore, but most shoes and sandals are cheap and inferior articles produced by native shoemakers in their homes. The largest consumption of leather in Madras is for bags for raising water from wells, and for oil and *ghi* pots. About a million water bags are required annually in Madras; they cost from six to nine rupees each and last barely a year. The Madras School of Art is producing these bags by the chrome tanning process, which requires some scientific knowledge and skill in manipulation. Chrome tanned leather is superior to vegetable tanned leather in many respects. It is soft, pliable, and impervious to damp. Once dried the leather can only with difficulty be wetted again, hence the finishing process must take place immediately after tanning. Hitherto ordinary tanners have only produced half-finished goods for export, and it is useless to introduce chrome tanning unless at the same time skins are made into marketable articles. The general opinion in Madras is that finished goods cannot be produced well and cheaply enough to be exported at a profit. Attempts to make chrome tanning on a commercial scale pay in Bombay and Madras do not appear to have succeeded. For success large capital and extensive plant are needed as well as intelligent labour. Mr. Chatterton thinks the first object should be to improve the supply of leather for local consumption, especially water buckets. The non-absorbent chrome-tanned leather is useful for these, for it becomes more flexible the more it is wetted. These buckets, though more expensive than existing ones, are twice or thrice as durable. Hence their use would involve an economy in the use of hides and more hides could be exported.

Taking India generally the native leather industry tends to decline with the larger exportation of raw material and the increased importation of leather goods—the extent of which shows the opening for local manufactures.

The Dyeing Industry.

After textiles and leather, in which dyeing is important, it is necessary to say a few words about this industry, which for centuries has employed a large number of hand-workers using indigenous dyes. The last census showed that there are 113,000 dyers of textiles and 81,000 leather dyers. In this, as in allied industries, a revolution has occurred. In the first place, special dyeing factories, equipped with steam machinery, have been established in the great textile centres, Bombay (which has three large works) and Ahmedabad, while up-to-date dyeworks have been added to cotton, woollen, and silk factories in the chief manufacturing cities. In the second place, imported aniline and alizarine dyes are superseding indigo and other long famous Indian vegetable dyes. Most Indian dyes are fleeting as well as expensive and troublesome to work, while the mineral dyes are cheap and easy to manipulate. As a consequence, imports of the latter have increased five-fold in 25 years, and they are increasingly used throughout India to the detriment of the small local dyers and of the producers of vegetable dyes, whose products are being ousted from both home and foreign markets. The two great German firms that deal in artificial dyes give free tuition in the use of their colours. Whether the cheaper and more brilliant tints are more attractive is a matter of taste, but they have undoubtedly captured the Indian market.

Indigo.

The only Indian dye-stuff that appears to involve the use of machinery for production on a considerable scale is indigo. This important article of trade, long a source of profit to European planters, has fallen on evil days owing to the encroachments of a mineral dye, synthetic indigo, chemically produced in Germany. Opinions are still divided as the relative merits of the natural and artificial dyes, and the former has not ceased to be used, though its competitor is increasingly consumed in Europe and America, in Egypt and Japan, which once bought large quantities of Indian indigo. Owing to the unfavourable prospects of the vegetable dye, the acreage planted with indigo in India has been steadily curtailed for some years, and last season, when the weather was bad, the area fell to 473,700 acres, as against 706,600 in 1900, and an average of 1,184,000 acres in the 10 years ended 1902. Hence the number of factories has fallen to 553, which afforded seasonal employment to 81,750 persons in 1903-4 in Bengal, Madras, and the United Provinces. The work is not highly specialised, and many of the small factories are owned and worked by natives. The German dye firms are said to have combined to raise the price of their synthetic indigo, which is believed by some to be produced at a loss, inasmuch as the processes of production are numerous and costly and there is no bye-product. In any case this increased price should benefit the Indian dye, the selling price of which has fallen heavily. Although experts are endeavouring to improve the cultivation and manufacture of indigo, the decline in the indigo acreage appears to imply that the planters expect very little result from these experiments.

Paper Mills.

Paper-making on European lines seems at first sight to offer great scope, but little progress has been made. There are nine mills—four in Bengal, four in Bombay, and one in Lucknow—with a total capital of about £450,000. Two have paid no dividends for some years, and two have done fairly well. During the last ten years production has increased from 29 to 43 million pounds. Most of the foolscap and much of the note-paper, envelopes, and blotting-paper used in the Government offices are now bought from the mills. The existing depression in the trade is attributed to large imports of cheap wood-pulp paper, which, if less durable, is more attractive in appearance than the Indian paper made from grass, jute cloth, &c. The chemicals required have to be imported, and they are expensive. Meanwhile imports of paper and pasteboard are increasing. The Forest Department is now inquiring as to the possibilities of supplying wood-pulp for paper-making.

Iron and Steel Manufactures.

A separate heading is assigned to this subject more owing to its intrinsic importance than because iron and steel manufactures have attained any notable development. The only iron-smelting by European methods is in Bengal, and the only works fully equipped for iron and steel production are those of the Bengal Iron and Steel Company at Barakur. There has been a general decline in the native charcoal iron industry within range of the railways, which distribute the cheap imported iron and steel, but in remoter districts the old industry survives, and in parts of the Central

Provinces has even improved, though the production is under 5,000 tons of iron and a little steel. In the Sambalpur district over 200 small direct process furnaces are still at work. Ore is produced in considerable quantity only for the company above mentioned, and in small quantities for the numerous native foundries in Central and Southern India and the East Indian Railway workshops at Jamalpur; but the annual average production of iron ore in Bengal for the six years ended 1903 was only 57,678 tons, valued at £8,338. It is regrettable that, owing to the non-existence of a steel-making centre in India, the rich deposits of manganese ore in Southern India are being exploited for export. If steel were made, a demand would arise for ferro-manganese, and the lower-grade ores, now neglected because they do not pay to export, would be developed.

Although India has room for a considerable iron manufacture leading up to the manufacture of machinery, there is, as just remarked, but one important ironworks. In the railway workshops, however, and in some large foundries in Calcutta and elsewhere, valuable work is done.

The Bengal Iron and Steel Company, during the year ended 30th September, 1904, produced 37,883 tons of pig-iron, and 13,958 tons of castings, *i.e.*, sleepers, chairs, pipes, columns, &c., mainly for irrigation works and water-works. The Company, which receives special encouragement from Government, has a complete plant for turning out 25,000 tons of steel per annum in the form of rails, joists, tees, angles, &c., and steel-making began in November, 1904. The steel is made by the basic open-hearth process, and is said to be fully equal to European and American steel. This is the first steel plant erected in India for steel production on a commercial scale from indigenous raw material. The blast furnace plant is now being enlarged so as to increase the pig-iron output by about 500 tons a week. The company's customers are chiefly the railway companies (especially the East Indian), but considerable quantities of pig-iron are sold to private foundries for conversion into castings. The iron and steel produced should be able to compete increasingly with the German and Belgian iron and steel out of which household articles are largely made in the bazaars. A small quantity of pig-iron is exported to Singapore, Colombo, &c., but local Indian demands absorb most of the production.

The railway engineering workshops are mainly engaged in the work of erection and repair—carriage and waggon under-frames and other metal-work being largely made from imported iron and steel. The East Indian Railway Company made a complete State train of eight bogie carriages at Lillooah in 1903, while at their Jamalpur works, which employ 10,000 men, locomotives can be almost completely built. The output at these works has enormously increased, and the Company aim at making all the metal work they require by means of their iron and steel foundries and rolling mills. The works are fitted with electric driving plant. Throughout the country great developments are taking place in railway workshops, and there seems no reason why India should not soon produce her railway material as well as war material.

The large private ironworks at Howrah and Kendua (Burdwan) employed 4,550 and 3,100 hands respectively in 1903. Besides these there are numerous iron and brass foundries scattered over India, though mostly in Bengal. England furnishes the bulk of the varied kinds of machinery required for India's nascent manufactures—cotton, jute, silk, wool, matches, screws, candles, soap, paper, brass, iron, flour, rice, &c.—and will probably long continue to do so, owing to her exceptional powers of producing complicated machinery. An Indian firm, however, is said to be supplying spare parts for cotton machinery.

Recently rich and abundant iron ore deposits have been found in the Central Provinces, and proposals are said to be under consideration to manufacture coke for blast furnaces, to preserve the bye-products—tar and ammonium sulphate (used as manure)—and to erect a sulphuric acid factory. If expectations are realised, an active development in iron and steel making is assured.

SUGAR MANUFACTURE.

The manufacture of sugar is an ancient Indian industry. At one time the East India Company exported large quantities from Bengal to England, but this trade was practically killed by a system of preferential trade designed to benefit the ever-importunate West Indian planters. Subsequently the growth of large refineries in Great Britain led to a renewed demand for Indian sugar, and a trade in unrefined sugar began from Madras, and has since continued, though it has dwindled to small dimensions. Lastly, there arose in India a sugar industry on modern methods and supported by European capital. The

output of these few refineries, and of a vast number of small native factories, has for a long time failed to meet the demands of a population who mostly use sugar as a daily food. Everywhere in India sweetmeats may be seen on sale, and they are bought by the poorest. An enormous expansion in the sugar industry, therefore, seems possible. At first the Indian deficiency in sugar was made up by Mauritius. For the last ten years large quantities of beet sugar have also been imported, while for two years past Java has sent large and increasing quantities of unrefined sugar. The abolition of the bounty system has not appreciably checked the beet sugar imports, and the total sugar imports into India for the last three years have beaten all records. It is clear from these facts that India, which is capable of producing enormous quantities of cane sugar, may profitably extend its cultivation. There are probably 3,000,000 acres under sugar, about two-thirds of the area being in the United Provinces and Bengal. Both are protected from foreign sugar by the long sea-voyage, and to a large extent also by long land transport. Instead of an increase in the sugar area in recent years, there has been a decline, ascribed to the preference given to grain and cotton crops. But in 1903-4 the acreage and yield were greater than in the previous year. For a considerable time the price of raw sugar (*gur*) has been very high, because of the urgent up-country demand for such sugar, which is little affected by foreign competition. This explains the large imports of Java sugar for refining. The chief requisite for an enlarged output is an improvement in the processes of cultivation and manufacture. Cultivation is unscientific, the methods of extracting the juice are defective, and there is great waste in refining, while the product is coarse. Hence the yield of cane per acre is small, and so is the yield of saccharine matter. Some native producers still use antiquated wooden mills, though the great majority have adopted the more expeditious and effective iron presses, which can be hired by the day in Bengal. Many difficulties have to be surmounted before India can oust foreign supplies and produce all her own sugar. The large demand for unrefined sugar, by keeping up its price, raises the cost of refining sugar, and so gives an opening for foreign refined sugars. These sugars are preferred by natives owing to their whiteness, which is due to the use of bones; but owing to caste prejudices bones cannot be used in the manufacture of sugar in India. The first requisite for progress is a much greater number of large central refineries worked by steam-power similar to those established at Cawnpore, Cossipore, and elsewhere. The manufacture is not complicated, and it requires no large proportion of skilled workers. One great difficulty is to obtain adequate supplies of raw sugar from the natives, who only cultivate on a small scale. A large refinery requires abundant and assured supplies of cane cultivated by the best scientific methods. Throughout the vast area of Northern India from the Punjab to Bengal a vast field is offered for sugar refineries on modern lines, and many of those at work already appear to be reaping good profits.

Tea Production.

Of the industries mainly agricultural, though partly manufacturing, the chief is tea, which is a manufacture to the extent of about one-third of its selling value. Since the industry began its expansion has been enormous. The establishment of large plantations and the use of machinery has cheapened production, while freedom from the adulteration and impurity that characterise the hand-made China tea has given it a preference over the latter. The large capital employed in the tea industry is nearly all British, and the labourers have been drawn, at great trouble and cost, from the congested tracts of India. Tea is the one industry of Assam, which, without it, would not have been developed. In recent years tea has passed through great vicissitudes. A too rapid extension of the area under cultivation caused over-production, and prices fell heavily. When the planters had taken active steps to remedy this evil by curtailing the acreage, by finer plucking, and by extending the sale in India and abroad, the English tea duty was raised from 4d. to 6d. a pound as a war tax. When the war was over the duty was raised to 8d. a pound, and though this addition has happily been removed, partly as the result of appeals made by the Viceroy, the increment assigned to war purposes still remains. The tax of course does not fall directly on the planters, but indirectly it operates against them by checking consumption, and by forcing them to keep down prices unduly in order to prevent a still greater fall in consumption. Thus, an article of prime necessity in the domestic economy of this country, an article produced almost wholly within the Empire, an article on which the incidence of taxation had much increased,

even with the fourpenny duty, owing to the fall in prices, is still exposed to a duty of nearly 100 per cent. *ad valorem* on the average price of tea, while the incidence on the cheaper kinds consumed by the most necessitous classes is much more severe. High duties have led to a resumption of coarser plucking, and have given an impetus to the importation of inferior non-British teas in order that the price of cheap blends may be kept down. Rubbishy teas which the United States, Canada, and Australia refuse to admit have been dumped down in this country. In all these Anglo-Saxon countries tea is admitted free of duty, while in the following countries, which are more or less Teutonic in origin, the duties per lb. are lower than ours:—Germany, 5½d., Denmark, 4d., Sweden, 3d., Holland, 2½d., Switzerland, 1⅔d. The consumption of tea in England has fallen from 6·16 lb. per head in 1901 to 6·01 in 1904, and clearly a heavier tax must raise prices and check consumption. Outside this country tea is making headway, and Calcutta is becoming to an increasing extent a great distributing centre for foreign markets.

Tobacco Manufacture.

The area under tobacco in India is practically stationary. Bengal, containing about half the acreage, manufactures little, but exports crudely cured raw material to foreign countries or to Burma for cigar-making. The well-known Indian cigars come mainly from Madras, which contains only about 15 per cent. of the tobacco acreage. A leading Madras firm that I consulted ascribed the non-expansion of the export trade to the unscientific cultivation and curing adopted in India as compared with America, the Dutch East Indies, &c., where the production is in European hands. The Madras leaf is too coarse, and is not suited for pipes and cigarettes, while for cigars, imported leaf from Sumatra is used as an outer wrapper. India itself offers only a small market for its own cigars, but their cheapness has led to a considerable demand abroad. An extensive foreign trade, however, cannot grow up until there is a large and regular supply of improved leaf of standard quality. The export of Madras cigars has recently declined, owing, it is said, to the diminished supplies required in South Africa since the war, but the export of Burma cigars has increased. Imports of cigarettes have greatly developed in the last four or five years, and natives of all ages and conditions may be seen smoking them throughout India. It is unfortunate that this extensive and growing market is not exploited by Indian planters. Several provincial governments are experimenting in tobacco, and the recent agricultural conference at Pusa recommended the appointment of a tobacco expert and chemist. India possesses soil and climate well suited for tobacco, but the industry requires European supervision, adequate capital for production on a large scale, and a supply of native skilled labour.

Lac Factories.

Many factories exist in Bengal and the United Provinces for the manufacture of lac, 45 out of a total of 93 being at Mirzapur. Lac is an incrustation produced by certain insects on the twigs of trees. The twigs are broken off and collected by jungle tribes, and out of the stick lac is made seed lac, from which the shell and button lac of commerce is manufactured. Steam-power is used in some factories, but handwork holds its own. The last Bengal administration report (1903-4) stated that in the Burdwan Division lac manufacture was declining through the competition of cheap foreign lac made by a chemical process. This competition, however, can hardly be serious as yet, for of late years the price has enormously risen owing to a sudden and apparently inexhaustible demand for lac, which is largely purchased for electrical purposes in England, America, and Germany. In spite of an extraordinary rise in prices and abundant supplies, consumption has increased. Unfortunately the large demand has led to adulteration with rosin.

Petroleum Production.

The increasing output of petroleum and its various products in Burma and Assam is very encouraging. Burma produced 85 million gallons in 1903, a growth of 55 per cent. in a single year, while the Assam output is increasing. The consequence has been a considerable decrease in imports of foreign oils. The Burma Oil Company refines the crude oil and manufactures gas oil, batching and lubricating oils, paraffin wax, and candles. This Company is enlarging its up-to-date refining plant, constructing a pipe-line to Rangoon, increasing its fleet of tank-steamers, and the number of its storage tanks for the distribution of oil in the chief Indian cities. In Calcutta candles are being made from wax imported from Burma. Owing to the production of

paraffin wax candles, a considerable export trade is springing up, while candle imports have diminished. India candle exports rose from £3,304 to £60,368 between 1901-2 and 1903-4, Australia, New Zealand, the Straits, and China being the chief purchasers. Government has prevented the intrusion of Trust Corporations of the international type into the Indian oil fields which, in 1903-4, yielded a royalty of £80,000 to the State. There is every prospect of a wide extension in the outturn of cheap mineral oil and its products.

FLOUR AND OIL MILLS.

These mills are taken together, because flour is not infrequently ground in the oil-mills. But so considerable has been the progress in flour-milling and oil-milling, and so great are their potentialities, that they may be expected to develop independently on a large scale. Flour-mills are general, especially in Bombay, the Punjab, and Bengal. The mills at the great wheat port of Karachi are flourishing, and developments are taking place. Large mills exist at Howrah, and new mills are being erected at Lahore, Umballa, and Allahabad. Besides the home trade, there is an export trade in flour, amounting in 1903-4 to over 40,000 tons. Of this five-sixths went from Bombay, chiefly to countries in the Indian Ocean. There seems no reason why this increasing trade should not find an outlet in Europe, and why England should not buy flour from India as well as from North America. Frequent complaints are made of the dirty character of the Indian wheat sent to this country, and it is estimated that from 5 to 10 per cent. of last season's imports consisted of clay and other impurities. If the wheat were milled before shipment freight would not have to be paid on thousands of tons of dirt, and more employment would be found for native labour.

With regard to oil it has often been suggested that the oilseeds now exported in vast quantities to Marseilles, Hamburg, Hull, and other European ports should be crushed in India, and the resultant oil either exported or manufactured into soap and other products. One great obstacle at present is the absence of a demand in India for the important bye-product, oil-cake, which finds a ready and profitable sale in Europe, whereas India uses little, and even exports much of what is already available. Oil-pressing is an ancient Indian industry, and though, for lighting purposes, kerosine is driving out vegetable oils, they are still widely obtained for other purposes from small mills, especially in Bengal and Madras. Thus the suburbs of Calcutta teem with castor-oil mills. The export of Indian oils is considerable and increasing. Cocoanut-oil, which has been largely imported, is now being largely exported from Madras. The total vegetable oil exports were £556,000 in 1903-4, as against £354,000 in 1901-2. Large capital is needed for economic production on a large scale, by which alone cheapness and uniformity of quality can be secured.

MINOR MANUFACTURES.

A considerable number of minor manufactures can be only adverted to briefly.

(1) *Manufactures proper.*—There are 27 breweries in India, which produce annually about 6,000,000 gallons, two-thirds of this quantity being brewed in the Punjab and the United Provinces. About one half of the output is bought by the Commissariat Department, while the remainder is sold to the civil and military population, chiefly Europeans in the hill stations. There are ten small distilleries, while some breweries and sugar factories distil rum. Coir manufactures are progressing as the increasing exports show. One coir matting factory in Travancore employs over 1,100 hands. Rope works are numerous and increasing; some near Calcutta are owned by Europeans, and there are many small native works, chiefly in Bengal and Madras. The Ghoosery works employ about 440 hands. Umbrellas are being locally produced from imported cloth and fittings. In Bengal, the Punjab, and the United Provinces are several large soap factories, which turn out very fair toilet soaps by European processes, while a great number of small native works in Bengal and elsewhere make crude soaps used by washermen and dyers. India now has many aërated water factories and numerous ice factories, though only a few produce on a considerable scale. Owing to their cheapness, ice and mineral waters are largely consumed by the natives in all parts. The manufacture of matches is of slight extent, though there is a great demand for consumption, as the large imports from Japan and Europe prove; but it is said that production is handicapped by the dearness of chemicals and lack of the proper kind of

wood. Among miscellaneous factories are a few small chemical works, gasworks, a mill for extracting and preparing agave fibre (Coorla, Bombay), perfumery factories (at Jaunpur and Ghazipur), brush factories, tent factories, &c. There is a large and increasing number of printing presses, which points to a wider diffusion of education. At the recent Bombay Industrial Exhibition were represented many nascent manufactures, including safes, locks, paints, &c. Art industries may be mentioned only to be dismissed from consideration. Though their production is widespread, and employs in the aggregate a large number of craftsmen who work by hand, their commercial importance, if we except carpets, already dealt with, is not great. There is, however, some export of shawls, jewellery and plate, brassware, ivory manufactures, wood manufactures, &c.

2. *Industries connected with Agricultural, Animal, and Forest Produce.*—Rice mills claim the first notice here. In 1903 they numbered 112, and employed 16,000 persons. This growing industry is important only in Burma, where large capital has been sunk in mills at the seaports. Practically, all the rice now exported is husked before shipment, employment thus being found for country labour, chiefly imported from India. The husks are used as fuel. Coffee works exist in the Madras Presidency to the number of 18. In recent years the coffee industry has greatly suffered from leaf disease and from Brazilian competition, resulting in a decline in prices. There are several bone-crushing mills at Karachi and elsewhere, bones being crushed for export to the extent of about 10,000 tons a year. Saw mills, like rice mills, are to be found chiefly in Burma, where the teak industry is important at Rangoon and Moulmein. Of 90 saw mills in India, 72 are in Burma and 11 in Assam. Much timber is used for tea and opium chests, for railway sleepers, carriages, trucks, &c. But the imports of manufactures of wood exceed the exports, which shows that there is scope for enlarging the output.

3. *Manufactures dependent on Mineral Products.*—Considering its great size India is not rich in mineral resources, and few of the minerals exploited are worked with scientific appliances. We have already dealt with iron and steel manufacture. An aluminium factory, owing its origin to the Madras School of Arts, exists in that city. It is now worked by a company, and the industry is said to be making steady progress. Considerable sales of sheet metal are made to native workers, who manufacture utensils from it in the bazaars. It is lighter than copper, which it is superseding. In a recent report on Indian mineral production, Mr. Holland has pointed out that India has a possible asset of great value in the deposits of laterite, which cover wide areas. It has lately been found that many of the deposits contain large quantities of alumina, which might be extracted on the spot, either for export as such, or for the manufacture of aluminium in the country. To prepare the alumina, however, would require caustic soda, not at present made in India. But its production is possible by the separation of chlorine, from which bleaching powder is prepared, by the electrolytic decomposition of dilute brine, and as caustic soda and bleaching powder are now largely imported for paper-making, there would be a market for both, apart from the requirements of alumina manufacture. Salt refineries exist here and there, and a large quantity of salt is evaporated from sea-water. Saltpetre refineries on a small scale are worked by natives in Calcutta and other parts of Northern India. A new industry is said to have been set on foot in Calcutta for making tea-lead out of raw material brought from Australia, the machinery having a productive capacity of 10,000 tons per annum.

Common clays are used everywhere for making bricks, tiles, and the cheaper kinds of pottery, while finer varieties are used for glazed pottery. There are two large potteries belonging to a Calcutta firm, one at Raniganj employing 1,050 persons, and one at Jubbulpore employing 584. They produce piping, tiles, and other large articles in considerable quantity. There are many small brick and tile works, chiefly in Bengal and Madras. India has two considerable cement works, one in Bengal and the other in Madras. The progress made in works for producing building materials is important, as large quantities of bricks, tiles, cement, piping, &c., are imported. India possesses plenty of ornamental building stone, but owing to lack of enterprise in placing it on the market in forms suited to the immediate requirements of builders, it is little used in the chief cities, its place being taken by Italian marble and Aberdeen granite. An important recent development has occurred in quarrying the limestones of the Khasia and Jaintia hills, partly for use in the manufacture of lime and partly for the manufacture of cement near

Calcutta. Limestone is also quarried near Katni, and most of it is carried a distance of 530 miles by rail to the Barakur ironworks for use in blast furnaces. The manufacture of mineral paints is small compared to the demand and to the natural resources in suitable minerals. Steatite, which is widely distributed, is used for making pots, dishes, &c. An inferior kind of glass, used for bangles, is made in various places from the common impure river sands and efflorescent alkali salt found in many parts of India, but attempts to make better glass on a large scale have hitherto failed, the chief difficulty being want of quartz sand of the requisite purity and of suitable quality. Mr. Holland, in the report already mentioned, refers to the fact that India has no deposits of free sulphur worth working, and makes some suggestive remarks, which I condense, on the value of sulphur and its products. He points out that there are considerable imports of sulphur and sulphuric acid, and that a cheap and abundant supply of the acid would be the key to many industries now enfeebled or non-existent, and would produce an economic revival. Thus, with cheap sulphuric acid, several chemicals for paper-making could be produced in India. If the by-products of coke-making were turned to account, there would be needed a supply of this acid, which is essential to most chemical and many metallurgical industries. It is a necessary link in the chain of operations involved in the manufacture of alkalies, with which are bound up the manufactures of soap, glass, paper, oils, dyes, and colouring matters, while as a by-product it permits the remunerative smelting of ores which could not otherwise be developed. The revolution in European chemical industries consequent on the cheapening of sulphuric acid, has nearly exterminated the manufacture in India of alum, copperas, blue vitriol, and the alkalies, has reduced the saltpetre exports, is robbing India annually of 100,000 tons of phosphatic fertilisers in the form of bones, and forces her to pay £10,000,000 a year for European products obtained from minerals identical with those lying idle in India. But though sulphuric acid and the alkalies are essential to so many industries, they can only be manufactured profitably when a country offers a market for the by-products. These conditions are rapidly ripening in India, and enterprising capitalists should remember that her present requirements are but a fraction of the consumption that will follow any material reduction in prices through local production.

Possibilities of Industrial Development.

In recent years much has been said by both Europeans and by Indians about industrial development, but though such discussion is not useless, development has so far been mainly on paper, and the oft-predicted outburst of industrial activity has not arrived. It may be inferred from the facts I have set forth, that though some progress has been made in certain fields, the total achievement has been small. When a country with 300 million people has only two advanced manufacturing industries employing more than 20,000 hands, when it has only one fairly large iron and steel works, and when coal production has stopped at about eight million tons because demand is slack, can we say that industry has attained any important development? Even the cotton and jute goods now forming the chief manufactures are mostly of the simplest and coarsest kinds, while silk, woollen, and leather manufactures have, except in a few centres, attained little development. Several industries merely carry raw products one stage towards their final form. The total population engaged in modern manufactures proper hardly exceeds a million, in other words, it is less than the annual increment of population in a normal year, free from famine or epidemics. Again, progress seems likely for some time to diminish rather than increase the artisan population by facilitating the competition of articles produced by modern methods with the cruder productions of the native artisans, who are thus driven into agriculture. The very industrial progress that has been commended as securing diversification of labour appears for the present to be tending in the opposite direction, and not towards the relief of pressure on the soil. If, however, we look beyond manufactures and take a broader survey, we find that modern conditions have opened up wide fields of employment for natives in railways, mines, irrigation works, the police, &c., and so made the supply of labour short of the demand in manufacturing industries.

India, in fact, must move slowly. The European capital and enterprise available are limited, and those who are unfamiliar with the conditions of Indian life and the customs and methods of the people must tread warily. The wealthier natives often lack the enterprise, education, scientific and technical knowledge, taste, and aptitude indispensable for industrial pursuits. Not until the

population is much better educated will their wants be greatly multiplied, and not until agriculture is far more developed can this enlarged range of wants lead to an effective demand for a variety of manufactured articles. The circumstances, then, of production and consumption alike preclude any rapid industrial development.

Meanwhile the possibilities of progress seem to lie in those simpler manufacturing industries that can give employment to large numbers of the population, and require only a minimum of skilled labour. The improvements that seem possible in the ancient handicrafts are desirable more perhaps for social than for economic reasons. But industrial development proper must lie in the substitution of locally manufactured goods for those largely imported, or in the manufacture of produce now exported raw. For a long time the latter must probably be the most fruitful sphere of effort.

In Appendix IV. will be found a list of the chief kinds of raw produce now exported. As half the cotton and jute are exported raw, there is clearly room for expansion in the manufacture of these, and it is gradually proceeding. Wheat can be much more profitably exported as flour, and an extension of oil-pressing by steam mills may be profitable if oil-cake can be utilised. Silk, wool, hemp, and various other fibres—especially that of the ubiquitous aloe—seem to offer scope for more extensive manufacture. For the present it is doubtful whether hides and skins, which fetch very high prices when exported raw, tanned, or dressed, can be profitably turned into leather and leather manufactures on a large scale, though gradual progress appears possible. A difficulty that must occur is whether India can as readily find a market for her manufactures as for her raw materials. But though she has no monopoly of wheat, oil-seeds, hides and skins, &c., her contributions to the world's markets are so considerable, that if any shortage occurred in her supply of raw materials due to their conversion into flour, oils, leather, &c., a demand would almost necessarily arise for the latter.

With regard to the substitution of locally manufactured goods, we have seen that India already produces more or less in the way of cotton, woollen, and silk goods, iron and steel, soap, candles, boots and shoes, harness and saddlery, sugar, matches, tobacco, bricks, tiles, cement, &c. She has produced with growing success cotton yarn and piece goods, because for these she has both a home and a foreign market. But in most of the articles enumerated the Indian products are inferior in quality, and a long time must elapse before India has the capital, enterprise, machinery, and skill to produce them. It is, for the present, more beneficial economically that she should import them, because it is more profitable to exchange her abundant agricultural wealth for articles in which her productive power is inferior. Even England cannot effectively compete with foreign countries in some of these commodities, *e.g.*, mineral dyes, glass, paper, &c. The cheapness of many of them lies in the fact that they are produced on a large scale for the world market by the most modern methods, and the cost of production would be relatively high if India merely tried to satisfy the demands of her own market. If we look down the list of manufactures in Appendix V., we shall see how large are most of the imports compared to the exports of such articles, and yet how small are the former considering the size of the population. Not only is India's capacity slight for producing sufficiently high qualities of these goods, but the question of taste has to be considered. In glassware, dress, millinery, footwear, &c., an enormous degree of variety is possible, and it is better to choose from all the products of Europe and America. India probably gets her imported manufactures more cheaply owing to favourable freight rates. Such goods occupy but little space, and the larger proportion of the freight charge for the round trip is paid for the bulkier raw produce that constitutes the return cargo. On the other hand, as pointed out in the closely-reasoned Indian Blue-book on Preferential Tariffs, raw produce so predominates in homeward cargoes that fancy freight rates are often charged for small consignments of manufactured goods, such as oil in casks, to the prejudice of Indian industry. The cheapness of outward freights has no doubt aided the sale of Continental manufactures—as Western Europe buys large quantities of raw produce from India. Their sale has been still further aided by legislation, which was designed to protect British goods, but has had a precisely contrary effect. At the recent Conference of Chambers of Commerce in Calcutta, a resolution was unanimously passed condemning the clause in the Merchandise Marks Act requiring all foreign goods to be marked with the country of origin, on the ground that it had tended to divert trade from

local British merchants to foreign agents located in India. Natives find it cheaper to deal direct with these agents than to buy foreign goods through English firms. The Act has secured a splendid advertisement for foreign goods, and one purchase has led to another, to the detriment of British merchants and ship-owners. The fact that the poverty of the natives forces them to study price before quality has given a still further advantage to Continental goods.

Government and Industry.

The Government of India has always recognised that it must render direct aid to industry, and never has this recognition been so marked as during Lord Curzon's viceroyalty. The central and local governments are spending large sums in research, undertaken in order to improve the staple crops that furnish raw material for manufactures—jute, cotton, silk, indigo, sugar, tobacco, &c. The establishment of the Pusa Research Institute, and the recent budget grant for agricultural experiment, research, demonstration, and instruction, all point to the Government's desire to improve India's premier industry on which all other industries turn. The essential work of primary, technical, and industrial education, in which India has much leeway to make up, has been taken in hand. Further, in pursuance of the aim to develop those Indian industries which seem most likely to attract native capital, scholarships are being granted to selected students to enable them to obtain instruction in Europe and America. Fully-equipped trade schools are to be established in the larger industrial centres where the need of trained artisans is felt by employers. Meanwhile, much valuable instruction is being given in railway workshops, mills, mines, &c., under European supervision. In these the natives acquire skill and knowledge and habits of order. Government has cordially co-operated in the late Mr. Tata's scheme for an Institute of Research. It may be hoped that similar schemes will be formulated for, and carried out in, the chief industrial cities, and especially that fully equipped laboratories will be established with highly-qualified chemists. In India, as in England, there has always been a neglect of science. More, however, has been done in the last few years than ever before in the appointment of scientific experts, and a Board of Scientific Advice has recently been constituted.

It is often said that Government should encourage Indian industries by purchasing more of its stores in the country. But there is a standing order that stores, if suitable in quality and price, shall by preference be purchased in India, and, to give specific instances, this is now done in the case of malt liquors and army boots, once bought in England. Most, however, of the stores now purchased for the army and the railways, as also stamps, scientific instruments, &c., could not be economically obtained in India. An important step recently taken is the erection of more Government factories for arms, ammunition, rifles, gun-carriages, cordite, &c., in order to render India independent of external supplies of war material, for which there are already eleven factories. The State also has factories for opium, quinine, turpentine, &c. State engineering workshops exist in connection with railways and irrigation works, while in the jails carpet-weaving, blanket-making, oil-pressing, &c., are undertaken. By extending railways Government has supplied certain conditions of successful manufacture—cheap transport for raw material and fuel, and also for the distribution of finished goods. Government in December last extended its support to the Bombay Industrial Exhibition, which was organised by Indians. Lastly, Government has instituted a Ministry of Commerce and Industry in order to concentrate the various official activities bearing on trade and manufactures.

In conclusion, I must return my thanks to a large number of officials and non-officials, European and native, in India and in England —too numerous to specify by name—who have helped me with information and suggestions, as well as to various writers, notably Sir George Watt and Mr. O'Conor, from whose works I have borrowed hints for this paper, which would otherwise have been far more incomplete.

APPENDIX I.—Manufacturing Industries by Provinces.

Every province has mills for ginning, cleaning, pressing, spinning, and weaving cotton, and every province also has printing presses. These are consequently omitted in the following list:—

1. *Bengal.*—Jute mills and presses, flour mills, oil mills, tea-gardens, indigo factories, lac factories, paper mills, silk filatures and mills, iron, steel, and brass foundries, engineering works, soap factories, saltpetre refineries, bone-crushing mills, brick and tile factories, cement works, sugar factories, ice factories,

mineral water factories, potteries, rope-works, chemical works, electrical works, gas-works, &c.

2. *Bombay*.—Dye-works, flour mills, bone-crushing mills, cement works, brick kilns, electrical works, gas-works, workshops for railway and tram plant, iron and brass foundries, silk mills, oil mills, woollen mills, tanneries, harness factories, boot factories, paper mills, breweries, distilleries, carpet factories, match factories, &c.

3. *Madras*.—Tobacco factories, coffee works, fish-curing yards, indigo factories, aluminium factory, foundries, coir factories, cement works, oil mills, rice mills, sugar factories, rope-works, tanneries, leather factories, tile factories, breweries, &c.

4. *United Provinces*.—Tanneries, boot and shoe factories, harness and saddlery factories, woollen mills, flour mills, oil mills, indigo factories, lac factories, sugar factories, paper mills, foundries, breweries, &c.

5. *Punjab*.—Flour mills, woollen mills, oil mills, carpet factories, sugar factories, tile works, breweries, &c.

6. *Central Provinces*.—Potteries and breweries.

7. *Assam*.—Tea-gardens and saw mills.

8. *Burma*.—Rice mills, saw mills, petroleum refineries, and foundries.

N.B.—In some cases the industries are not wholly carried on by mechanical power.

APPENDIX II.—The Principal Manufacturing Industries, with the numbers employed according to the Financial and Commercial Statistics (1903-4) and the Census of 1901.

	Financial and Commercial Statistics.		Census, 1901.	
	No. of Factories, &c.	Daily average of Employees.	Numbers occupied— In Mills.	In Handwork.
Cotton mills	204	186,271	185,876	3,369,967
Jute ,,	38	123,869	78,786	—
Indigo factories	553	81,749	8,249	—
Cotton ginning, cleaning and pressing mills	895	75,625	42,117	243,743
Iron and brass foundries	76	22,338	7,904	620,721 *
Jute presses	155	20,996	5,501	—
Rice mills	112	16,223	42,676	—
Printing presses	107	13,220	23,370	3,295
Silk filatures	63	9,158	10,870	137,323
Tanneries and leather factories	43	7,907	8,928	1,022,373 †
Saw mills	90	7,888	—	—
Lac factories	93	7,635	6,649	—
Brick and tile factories	59	6,435	8,809	79,482
Sugar factories	21	4,896	28,118	91,099 ‡
Coffee works	18	4,726	—	—
Oil mills	99	4,629	5,851	529,421
Paper mills	9	4,523	25,140	3,295
Woollen mills	6	3,041	—	46,634
Woollen weaving establishments not classed as mills	11	4,427	—	27,933
Silk mills	10	2,793	2,428	—
Flour mills	35	2,649	3,882	415,718
Rope works	14	2,535	2,761	233,694
Breweries	27	—	886	—
Aërated water and ice factories	21	756	7,363	—
Distilleries	10	378	4,128	23,840
Petroleum refineries	—	—	3,644	—
Railway and tramway factories	—	—	17,267	—
Engineering workshops	—	—	9,522	—
Miscellaneous	149	17,549	41,604	247,074
Total	2,918	632,116	582,329	7,095,612

* Includes copper and hardware. † Includes leather factories. ‡ Includes sellers.

N.B.—The statistics in the two first columns are admittedly incomplete, and the figures cannot, therefore, be accepted as accurate. The census figures also are of uncertain value. It will be observed that the figures in the Financial and Commercial Statistics give the "daily average" of employees, and not the total number occupied.

APPENDIX III.—Distribution of Indian Cotton Mills in 1903-4.

	Mills.	Spindles.	Looms.	Employés.
Bombay Presidency—				
Bombay City	84	2,638,830	25,359	88,446
Ahmedabad	32	509,928	6,643	20,125
Other Places	25	480,528	3,392	18,584
Total, Bombay Presidency	141	3,629,286	35,394	127,155
Bengal	10	450,962	213	10,230
United Provinces	9	309,620	3,215	8,940
Madras	12	287,706	1,747	12,340
Central Provinces and Berar	9	198,532	2,649	10,606
Punjab and North-West Frontier Province	8	114,008	475	3,201
Ajmer-Merwara	1	12,312	369	708
Total, British India	190	5,002,426	44,062	173,180
Native States	9	145,318	1,020	5,457
Pondichery	5	65,600	1,339	7,634
Grand Total, India	204	5,213,344	46,421	186,271

APPENDIX IV.—Chief Exports of Indian Raw Materials.

	Quantity.	Value.		Quantity.	Value.
		£			£
			Brought forward	—	24,384,960
Cocoanut Kernel (copra) cwt.	353,724	281,640	Hemp, chiefly Sann .. cwt.	477,309	323,590
Wheat „	25,911,312	7,392,640	Hides, raw „	670,792	2,111,690
Sugar, unrefined „	198,005	58,700	Skins, raw „	265,325	1,779,120
Manganese ore „	3,623,789	152,940	Jute, raw „	13,721,447	7,812,080
Tobacco, unmanufactured, lb.	11,367,996	85,750	Lac, Stick and Seed „	6,383	29,280
Bristles and Fibre for Brushes, &c. cwt.	83,258	138,420	Seeds „	24,681,424	9,677,220
			Silk lb.	1,862,316	422,830
Coir „	25,500	15,110	Wax cwt.	6,685	29,410
Cotton „	7,931,075	16,259,760*	Wool, raw lb.	33,234,775	918,260
Carried forward	—	24,384,960	Total	—	47,488,440

* The value of cotton is abnormal, owing to a high range of prices.

APPENDIX. V.—Imports of Foreign Manufactures and Corresponding Indian Exports of Manufactures in 1903-4 (including Government Stores).

	Foreign Imports.	Indian Exports.		Foreign Imports.	Indian Exports.
	£	£		£	£
Arms, Ammunition, and Military Stores	746,000	28,000	Woollen manufactures	1,519,000	183,000
Cotton, Twist and Yarn	1,428,000	5,894,000	Apparel (including Boots and Shoes)	1,389,000	187,000
„ Piece-goods	18,366,000	989,000	Bricks, Tiles, and Cement	170,000	8,000
„ other manufactures	944,000	98,000	Cabinet Ware and Furniture	90,000	24,000
Flax and Hemp manufactures	161,000	1,000	Candles	64,000	60,000
Jute, Twist and Yarn	—	5,000	Carriages and Carts	310,000	—
„ Bags	41,000	3,043,000	Coir manufactures	3,000	319,000
„ Cloth	2,000	3,230,000	Cordage and Rope of Vegetable Fibre	39,000	41,000
„ Canvas, Rope, Twine, &c.	32,000	34,000	Earthenware and Porcelain	190,000	3,000
Silk manufactures	1,222,000	56,000			

APPENDIX V.—*Continued.*

	Foreign Imports.	Indian Exports.		Foreign Imports.	Indian Exports.
	£	£		£	£
Glass and Glassware	674,000	6,000	Tea-chests	92 000	—
Paper and Pasteboard	398,000	—	Wheat Flour	9,000	353,000
Hides, dressed and tanned ..	12,000	410,000	Umbrellas	164,000	—
Skins, dressed and tanned ..	49,000	1,656,000	Wood manufactures	50,000	27,000
Instruments, &c.	531,000	—	Oilcake	—	261,000
Jewellery and Plate..	100,000	15,000	Oils (vegetable not essential)	62,000	556,000
Lac (button, shell, &c.)	—	1,787,000	Metals and Metal manufactures (including hardware and cutlery, machinery and mill-work, and railway plant and rolling stock) ..	14,544,000	90,000
Leather and Leather manufactures	184,000	20,000	Sugar, refined	3,823,000	11,000
Matches	337,000	—	Tobacco, manufactured ..	311,000	54,000
Mats and mattings	18,000	4,000	Malt liquors	373,000	—
Paints, Colours, &c.	285,000	—	Miscellaneous	1,281,000	77,000
Perfumery..	21,000	9,000			
Paper and Pasteboard	398,000	—			
Soap	177,000	2,000			
Stationery..	287,000	—			
Toys and Requisites for Games	182,000	19,000	Total	51,078,000	19,560,000

N.B.—The above list is not exhaustive. Many articles—tea, indigo, petroleum, dyes, tans, provisions, opium, &c.—which are not usually classed as manufactures, are excluded. Some of the imports are re-exported, but not in sufficient quantities to necessitate special mention, with the exception of metals and metal manufactures, £254,000, cotton yarn and manufactures, £916,000, and apparel, £114,000.

DISCUSSION.

HIS HIGHNESS THE CHAIRMAN said they had all listened to the paper with great attention, not merely for the purpose of satisfying their curiosity, but in order to analyse the views expressed by the author. He did not propose to go into much detail, because the subject was an important one, and could not be fully dealt with on the spur of the moment and without preparation. He would, therefore, express a few simple ideas which the audience would take for what they were worth. The subject of the manufactures of India was of vital importance to the future prosperity and progress of the country, and he was glad to find that so many gentlemen in England, both officials and non-officials, were paying attention to it with a view to its solution. What the solution would be remained to be seen. A few years ago at a conference held at Ahmedabad he had the pleasure of delivering his views at some length, and, in order not to inflict them again on the audience, he would refer them to the speech he delivered on that occasion. He thought the greatest want in India was education in its widest sense, and he thought they should look back to the past history of the country in order that the path for the future might be seen. Before the advent, or almost at the beginning, of British administration, India had manufactures of its own which vied successfully with those of the rest of the world. Although the form of government had changed, he could not say that the present inhabitants had lost all the past glories and intellect of their ancestors. Given proper opportunities and facilities, he saw no reason why the descendants of the Hindus of the past should not hold their own in 1905. Difficulties arose from lack of knowledge, not only technical knowledge, but knowledge of the requirements of the world and of the best markets in which natives could sell their products at the greatest profit. How many Indians had any idea that the beautiful lacework made in different parts of India, especially Kashmir, would be valued and appreciated to a great extent in the markets of Europe? If the people did not know where the markets were how could they be expected to persevere with their industries? In order to avoid that difficulty he thought the first essential was to extend the limit of their knowledge; and when that had been done the articles produced in the country would be bought in other countries at a price which would pay the producers ten-fold. Had the Government of India done sufficient to promote technical education; had it exhausted its resources; were there no chances of doing more than they had done? They should congratulate themselves and be grateful to the Government for what it had done; but as an Indian whose interests were bound up with the country he held that the Government had yet much to do; and he hoped the future history of the country would show that the Government had always done its utmost to achieve that goal. He agreed in many respects with the remarks the author had made in connection with

both the skilled and lower classes of labourers in India, but he thought there were many points in favour of the Indian workman which went to accentuate his deficiencies. A man who did his work quickly and with regularity would be more in demand than one who was remiss in those respects. In India the masters were often too lenient; if a man was irregular they put up with him. But in the present days of competition and "push" they could not afford to be so lenient; they must be strict in order to teach workmen to be regular, and in order that they might hold their own in the world. In Baroda he had made several experiments, and had advanced money to different traders and merchants in the hope that they in their turn might make loans to support and encourage industries. The experience he had gained in that respect was not an uncommon one. Government was probably one of the worst agencies to manage industrial undertakings; and Baroda had been no exception. He hoped, however, that the failure in Baroda would not discourage other States or the British Government. Each State had its own difficulties, and particularly the Native States. The labour market was not at their call, and they could not employ the best educated and most intelligent men at their will; but Governments, which had greater facilities in that respect, could do such things with greater success than small States, which at present merely carried on the primitive functions of government. The people were satisfied with the exercise of primitive functions of government, because they were ignorant of their position and rights; they were ignorant of what they should demand, and the manner in which they should demand it. Ignorance was the problem which had to be fought against everywhere; if that were removed he saw no reason why the patient, sober, clever, intellectual labourers of India should not be able to hold their own with the labourers of the rest of the world. If many people in this country saw the beautiful designs and finished articles which were made in Kashmir they would be astonished at the amount of time and patience that were put into the work. If the artificers only had men to guide them who knew where the articles could be sold he was perfectly certain that Kashmir would have hundreds of factories with thousands of clever workmen who would do the utmost credit to any employer. Baroda could not boast of many mills; practically there was only one, which he started himself as a Government concern. He started it, not in order to increase the revenue or to fill the coffers of the State, but in order that it might be an example or lesson to the people of the country. That mill had been worked with more or less success, not probably with as much success as would have been attained had it been a private enterprise, but it had done as well as could be expected under the circumstances. Just before leaving India he sold it to a citizen of Baroda, and it was now being worked privately, an object he had had in view for some time. He was glad it had been taken up by a private individual, not because he was able to get rid of the responsibility of looking after the mill, but because it showed that the people of the locality were becoming more enterprising and confident of being able to manage affairs which really pertained to them. Before leaving India he also had several offers from different people in the State saying that they were anxious to open mills; he was cautious, not suspicious, and until he saw the mills working he would suspend his judgment. He told the people that he would be the first to give them as much encouragement as he possibly could. The greatest encouragement a Government could give was a minimum of taxation and of Customs duties. With facilities in the way of education, with knowledge of the world, with security, liberty, and right in property he thought the Government could do a great deal. In that respect the Native States had no reason to complain, but as an Indian he thought the Government should give them still greater knowledge in order that they might be able to appreciate the good that was being done, and with that increased knowledge be able to protect their own interests. With increased knowledge they must also have increased interest and increased power in the management of State affairs. In India, where every initiative had been crushed out for centuries, it was necessary, in order to encourage the people, to give them scope for enterprise, and to treat their failures up to a certain extent with leniency. They should be told not to commit the mistakes again in order that they might rise to a higher level in the future. There was no greater teacher than experience, and if the natives were given scope and a legitimate share in the affairs of Government, that experience would stand them in good stead in the management of their own affairs which belonged to the private citizen. He thanked the audience for the patience and kindness with which they had listened to his remarks, which had been unfortunately lacking in the preparation which he would have wished to give them, and, in conclusion, he most heartily thanked Mr. Tozer for his learned and eloquent paper. The subject was complicated, and people held different views, but in the multiplicity of opinions he thought some simple solution might be found. With that view he thought they should always be prepared to listen with an open mind to any opinions that might be expressed, and ultimately come to the conclusion which was most consistent with their own knowledge and conscience.

Sir George Watt, C.I.E., said that in dealing with the subject of the handicrafts of India it was customary in English audiences to hear caste extolled into a feature of the greatest magnitude and importance, and as practically determining the commerce of India. With that view he did not agree. He had travelled all over India and devoted a great many years to the study of its industries, and had

come to the conclusion that some of the most important and pressing aspects of Indian enterprise centred far more round the great European than Native industries. That might seem very contradictory to what had been said in the paper, but he thought that when it was looked into carefully it would be found true. The Chairman had referred to technical education as one of the most pressing necessities of the future. Technical education essentially meant the development of the industries, on lines not familiar to the natives of India themselves, but in the methods, appliances, and means practised in Europe. He, therefore, held very strongly that the industries of India should be more studied on the lines of modern commerce than as ancient industries. Comparatively few of the crops cultivated in India, in the present day, were indigenous plants, and many had been introduced within comparatively recent times. That fact alone showed that India was undergoing a radical change in every direction. In the same way the handicrafts could not be practised as they had been for centuries, if India ever hoped to compete against the world. Mention had been made of the efforts undertaken by the Government in some districts to improve hand-weaving. He thought it was very desirable if possible that the weaving should be improved, but it must be remembered that India had to compete against Manchester, Germany, America, France, Japan, and other countries that were not using the looms made by their grandfathers or great-grandfathers, but the most advanced and improved machinery the world possessed. If the people of India were taught what our grandfathers had abandoned, neither the foreign, commercial, nor the interests of the people of India would be advanced. Some scheme would have to be developed which would embrace not only technical education, but a system of extending a helping hand to enable people to start on the lines of success, not of failure. The bulk of the modern industries of India were foreign. The present cotton industry, for example, was a new industry. Mr. Tozer had referred to the fine work turned out by the hand-looms, but it was a fact that the finest muslins made in Dacca were only four hundreds, and machinery turned out six hundreds. It was a fact that hand-labour could not do what machinery could do, while machinery could do anything that the hand could do. The only limitation was in the market. If an article was too unimportant to command a manufacturer's interest then it would remain, but if it would give profitable returns one might depend upon it that European machinery and European brains would compete against every handicraft, and had done so. He, therefore, thought His Highness, in referring to technical education, had struck the keynote of the whole future of India. It was a pressing necessity that the people should be taught how to compete against importation. Three million bales of cotton were produced annually in India, of which half was exported as raw cotton. The other half was almost entirely used up, not by the hand-looms but by the power-looms. Half of the manufactures of the looms—yarns and piece goods—were exported, so that only a quarter of the total cotton crop of India remained for the people. Three-quarters of the people who were engaged in this modern cotton trade would, therefore, be deprived of their livelihood if the cotton mills were closed for export manufacturing purposes. The most important interest in cotton was, after all, its agricultural value. A great portion of the yarn spun in power mills was sold to the hand-weavers of India, and a large amount of yarn was also imported for the purpose of feeding the hand-looms, the goods turned out by the hand-weavers finding a ready market. Hand-woven goods were distinctly preferable in many respects, especially when they were made up into goods of a special kind with which European competition was not likely to interfere. The whole subject turned on the point that the bulk of the natives were using European spun yarn, either spun in England or in India by power-looms. The hand-spinning of yarns in India was practically a thing of the past, and the hand-looms were also bound to become things of the past, though this was doubtless much to be deplored. It was, therefore, of the very greatest importance to India that the Government should endeavour by some means to educate the people how to compete against foreign importations. The most important step that had been taken for a long time was, he thought, that made by the Viceroy, quite recently, when he founded a Commercial and Intelligence Department. He thought the people of India had every right to congratulate themselves that a step in the right direction had now been taken, and that the Commercial Department would do great service to the country.

Mr. M. C. MALLIK said he was glad of the opportunity of being permitted to express the pleasure he felt, which was doubtless shared by all present, at seeing his Highness presiding at a meeting connected with India in the metropolis of the Empire. It showed that the union and solidarity of the Empire were being strengthened by forces beyond the powers of short-sighted politicians to hinder. The subject of the interesting paper was of profound concern to all interested in the welfare of India and of the Empire as a whole. It had for years been a general complaint that the indigenous industries of India were decaying, that manufactures were languishing, and that all kinds of artistic work handed down from a remote and glorious past were, through want of encouragement, dying out. Each man, official or non-official, European or Asiatic, might give what explanation he liked in regard to the causes of that decay, but it seemed to him that by the most inscrutable dispensation of Providence the destinies of the ancient land of the Aryans, perhaps the most conservative on the face of the globe, had been linked with those of the land of the Anglo-Saxons, now the most progressive power amongst mankind.

The manufactures of India had, like everything glorious, in the past been taking a long slumber, and through the instrumentality of England pressure had been brought to bear upon that long-dormant force to wake it up to life and activity. A halo of glory was now in store for those who would guide the just-reviving forces of national regeneration, amongst which the revival of national industries must hold a conspicuous place. The sun after being under a cloud for centuries was now rising over Asia, and owing to the attainment by Japan of a leading position in the world it might be expected that Asiatic manufactures and fashions would be sought after by all the more advanced and wealthy nations of the world. It behoved India not to lag behind. The importance of India to the Empire might be imagined by a study of the statistics of trade. It would be seen from the statistics that the trade of India with the United Kingdom was more than equal to that of any two of her rivals, the colonies, combined, and one could imagine what that trade would be if instead of being forsaken, India were happy and prosperous under a liberal *régime*. The author had referred to the work done by the labouring population of India, and had stated that there was a disposition among the workers to do less work for more pay. He was not sure that that weakness was confined to India alone. It was well known that Baroda, under the enlightened rule of his Highness, had become a model State, and in order to give the same impetus to advancement in every department all over India, the officials, from the Secretary of State and the Viceroy down to the lowest policemen and all non-officials, from the great chieftains to the humblest peasant, should feel that the interests of India and England were identical, and that one could not be injured or benefited without corresponding injury or benefit to the other, and that impartial justice and a sense of security were the primary conditions of national advancement in every latitude.

Mr. TOZER, in reply, thanked the members for the kind reception they had given to his paper. He was sure everyone would agree with his Highness's eloquent speech with regard to the promotion of education. The Government of India had already done a great deal in that direction in the last few years, especially in the promotion of technical and industrial education. Progress, however, must necessarily be very gradual, and, as was found in this country, the financial aspect of the matter had to be very carefully considered. With regard to the subject of Indian labour, he hoped he did not insist too strongly on one side of the question. Everyone knew how patient and industrious the Indian labourer was. When he dealt with certain defects he was thinking more particularly of factory workers, and what he said concerning them was accurate. He agreed entirely with Sir George Watt's remarks on the purely economic aspect of handicrafts, and, in the last paragraph of the section dealing with that subject, he anticipated what Sir George had said. But he had added that this was as much a social as an economic question, and the proposals for improving hand-looms and for aiding handicrafts generally had for their object to tide over the period of stress from which the people were suffering. Moreover, the decay of the handicrafts meant the throwing out of employment of several million workers, and it was very important socially that those people should not be too rapidly forced to find other occupations. Even in a country so advanced industrially as Austria-Hungary the State is endeavouring by positive measures to arrest the decline of the small industries. It aims at correcting the antiquated notions of the small mechanic and at educating him in modern methods of production by systematic courses of instruction. Further, under the auspices of the Ministry of Commerce, he is assisted in purchasing small machines and tools (see Consular report on Austria-Hungary, No. 3,343, of 1905).

Sir WILLIAM LEE-WARNER thought all present would go away from the meeting with the conviction that a great work had been done in India, but that a greater work remained to be done, in the doing of which both Indian and Englishmen must work together and use their utmost endeavours. It had always been the desire of the Society of Arts to develop its Indian branch, and several papers were read every year on Indian subjects in order that in the Mother of many capitals throughout the world there might be a more extended knowledge of that great part of the British Empire, the Indian Empire. They, therefore, particularly welcomed the help rendered by his Highness in taking the chair, the more so because he was present at some sacrifice, having come home in order to recruit his health. Although his Highness sought leisure he had been willing on the present occasion to appear before a large audience and show that he took an active interest in the work the Society was doing, of which he was glad to say his Highness's brother was a member.

The CHAIRMAN thanked Sir William Lee-Warner for his exceedingly kind words, and said that in conclusion it was his very great pleasure to propose a vote of thanks to Mr. Tozer for his exceedingly interesting paper.

The resolution having been carried unanimously, the meeting terminated.

Mr. ALEXANDER ROGERS writes:—The paper read before the Society on the 11th ult. was excellent as far as it went in placing before us the general position of Indian manufactures, but failed entirely to point out how that position could be improved in the future by stimulating other industries indigenous to the country, and thus adding to the means of employment and wealth of the people. One of the

principal wants necessary to be provided for is the development of industries to take the place of agriculture and afford means for the subsistence of agriculturists in times of failure of crops and famine, at which periods they have nothing to fall back upon to earn a livelihood and consequently starve, and it is with a view to suggest several perfectly feasible methods by which this state of matters can be improved that I now address these few words to the members of the Society. The first of these is the improvement of paper-making. The use of writing paper, produced by native methods, is, of course, universal, but the quality of the material made is capable of very great improvement by the most ordinary attention and care. At present, I believe, no precautions whatever are taken to ensure the cleanliness of the rags out of which the pulp is made, the consequence being that the paper is dingy, dirty, and full of impurities which could be obviated by simple thorough washing in pure water before they are converted into pulp. The paper referred to contained no statistics with regard to this universal industry, and as there must be many millions of tons manufactured by crude native methods throughout the country every year, it may be imagined what a vast scope there is for the employment of capital, native as well as foreign, in this one industry alone. Among the industries now in existence enumerated in Mr. Tozer's paper I find no mention made of another very universal one connected with the improvement of leather, in which there is a very large field for the employment of capital, viz., in the preparation of the bones, horns and hoofs of the animals from which the hides for the leather are obtained. I believe the horns and hoofs are to some extent made use of, but by what agency they are collected I am not aware. The bones, which would form the base of the valuable agricultural manures so much needed throughout the country, are almost entirely wasted. In now speaking of the wild or Tasar silk industry, which would afford almost unlimited scope for the employment of capital, I refer specially to the Bombay and Madras presidencies, in which, strange to say, the example of Bengal, the Upper Provinces, and Kashmir has not been followed, although the worm—of which the moth bears the entomological name of *Antherea Mylitta*—is indigenous to both of them. It does not require the mulberry for its food, but lives on the leaves of some of the commonest jungle trees, so that the introduction of the culture would require no expense whatever. If paid for the collection of the cocoons, the Bhils, Warlis, Kátkaris, Kolis, and other wild tribes would find congenial employment in placing-out the eggs on the various trees in the jungles, and, with the assistance of their women and children, in keeping off the birds which would otherwise prey on the growing worms until they formed their cocoons on the branches. It would cost no long time and but little expense before the women would learn to spin off the silk from the cocoons and find remunerative employment, especially in time of famine, when agriculture failed them, to gain a livelihood. Silk manufacturers would soon establish depôts at village fairs and market places where this silk, for which there is an almost unlimited demand in England and on the Continent, particularly in the south of France, would find ready purchasers. A large and growing industry would thus be started which would prove of inestimable benefit to the country and to the agriculturists generally when the monsoons failed and their ordinary sources of employment and wage earning gave out. The few things that are here pointed out are ready to hand and need but little organisation and capital to carry out without delay. There are, no doubt, numerous other indigenous industries which could be started with the aid of a little thought, to the great good of India and her people; and it is to be hoped the attention of capitalists will soon be directed towards them.

ELECTRIC LIGHTING IN ST. PANCRAS.

At present discussion centres largely upon electric lighting, and within the metropolitan area St. Pancras was the pioneer borough in this direction. It is now more than thirteen years since the borough authorities determined to supply St. Pancras with the electricity it required. At first progress was slow and failures many. That was inevitable with a new enterprise of the kind; but if the Council's figures are to be accepted, with the exception of the first year (1892), when the year's working showed a loss of £1,543, and in 1896, when there was a loss of £1,950, each year has shown a profit, which, in 1904, was no less than £20,583. The tables (p. 785), which are official, show the progress of the undertaking since its commencement.

It will be noticed that whilst since 1896, and with the one exception of 1903, there has been a steady reduction in the average price obtained year by year, the revenue has continuously and rapidly increased, and the net profit is now very large. From September last the maximum demand system was reduced from 6d. per unit the first hour and 3d. after, to 6d. per unit the first hour and 1½d. after; the flat rate was reduced from 5d. to 4d. per unit, and the power supply from 2d. to 1d. per unit. The basis of charge for public street lighting has also been reduced. There are now only eighty possible consumers for motive power remaining in the borough to be secured as customers. Three great railways—the Midland, Great Northern, and North-Western—have their headquarters within the borough, which would naturally like to supply them with motive power, but they will probably prefer to remain their own suppliers. The large reduction in the cost of production during the last three years is due to better load factors, improved facilities for manipulating machinery, and the greater efficiency of machinery. St. Pancras has done much to weed out old

machinery, but it is necessarily at a disadvantage as compared with boroughs which went into the business later, and were consequently enabled to avoid some of the mistakes of the pioneer borough. The financial position of the undertaking in St. Pancras is sound. The total capital expenditure stands at £460,368, last year's profit, as stated, being £20,583, and with two exceptions every year since the start has shown a profit. It is not surprising that some members of the Council were desirous of allocating a part of the profits in relief of the rates, but we read in the report that "the Council endorsed the committee's view that the soundest policy, having regard to the amount of the capital expenditure, is to consistently transfer to the reserve fund all available profit until that fund has reached the limit allowed by Parliament, namely, ten per cent. of the capital expenditure. With the two-fold object of building up a substantial reserve fund, and paying towards the relief of the rates, the committee recommend the Council to reduce the charges for supply, believing thereby that the objects desired will be earlier brought about by the increased business that will naturally follow the lowering of the price."

	No. of Consumers.	No. of Lamps, &c., applied for.			Units Sold.	Total Revenue.	Works Costs.	Net Profit after providing for Interest and Sinking Fund.	Price.			Average price obtained.
									Lighting.		Power.	
		Incandescent 16 c.p.	Arc.	Motors.					Max. Demand System.	Flat Rate.		
						£	d.	£	d.	d.	d.	d.
Dec. 1892..	172	9,990	82	11	—	11,003	3·35	1,543—	6·3	6	3	—
,, 1893..	238	12,851	110	19	—	15,022	3·11	1,558+	6·3	6	3	—
,, 1894..	349	15,542	129	22	719,484	16,931	2·46	1,753+	6·3	6	3	5·64
,, 1895..	447	19,195	139	37	849,987	18,921	2·72	935+	6·3	6	3	5· 5
,, 1896..	672	26,423	187	47	1,201,229	27,089	2·80	1,950—	6·3	6	3	5·41
,, 1897..	808	32,250	256	78	1,520,354	33,347	2·26	6,518+	6·3	6	3	5·26
,, 1898..	984	38,124	292	91	1,996,877	38,256	2·32	4,175+	6·3	6	3	4·59
,, 1899..	1,184	46,172	315	126	2,477,508	44,880	2·05	6,842+	6·3	6	3	4·34
,, 1900..	1,438	57,456	426	152	3,008,481	49,329	2·02	2,922+	6·2	5	2	3·93
Mar. 1902 15 mths.	1,806	66,999	523	211	4,729,840	74,503 15 mths.	1·90	5,090+	6·3	5	2	3·77
,, 1903..	2,046	75,156	646	259	4,205,050	68,372	1·45	16,818+	6·3	5	2	3·90
,, 1904..	2,280	84,788	759	312	4,730,341	75,774	1·21	20,583+	6·3	5	2	3·84
Six months (ending 31st Dec., 1904)..	2,454	—	—	—	Six months ending 31st Dec., 1904. 2,789,675	31,791	1·08	Estimated for 12 months. 18,000+	6-1½	4	1	2·73

The St. Pancras authorities claim that at the price now charged in the borough electric light is as cheap as gas (not incandescent), and the committee hope soon to be in a position to reduce the price another halfpenny, say to 6d. and 1d. But there can never be very general use of electricity by the small householder until he is relieved of the cost of wiring. He may wish to use the electric light rather than gas, he may believe that having regard to its greater cleanliness, and other advantages, it is cheaper than gas, but he will not spend £10 or £15 for an installation in another man's house, and may not be prepared to do so even in his own. The boroughs are alive to this difficulty, and the London County Council is now asking authority from Parliament to make loans to borough councils for the purpose of free wiring. If Parliament assents, as it is likely to do, there will be something like a revolution in house lighting in London. The electric lighting of the ordinary residential house will then soon become general.

Mr. Sydney Baynes took over the work of Chief Engineer in 1895.

CORRESPONDENCE.

BRITISH WOODLANDS.

Only ill-health has hindered my writing ere this to thank Sir George King for his vindication, in the Society's *Journal*, of the 5th inst., of General Michael's meritorious services in the promotion of Forest Conservancy within the British Empire. I ought myself to have been the first,—and would have been but for long-engrafted and now most disabling malaise—to couch a lance in support of his claims to recognition in this connection; but I am indeed grateful to have been anticipated in the duty by Sir George King, who is far better qualified for its dis-

charge,—except that he cannot surpass me in respect for General Michael's work in Imperial Forestry, and reverence for his character as "an officer and a gentleman." I venture to express my entire concurrence with Sir George King's authoritative appreciation of General Michael's paper on "Forestry and Forest Education," published in the Society's *Journal* of the 21st December, 1894: and I may add that when the Report of the Select Committee of the House of Commons, referred by Sir George King, was published in 1902, I was both surprised and disappointed to find that none of the admirable suggestions made in General Michael's paper had been referred to by the Committee, notwithstanding that the Committee reproduced in the Appendix to their Report quotations from the writings of others of far less value and interest than many they might have given from General Michael's paper. I know that General Michael's paper was in the hands of the Committee for I sent a copy of it to Mr. Munro Ferguson, M.P., the Chairman of the Committee, who acknowledged the receipt of it in most cordial terms. The simple matter of fact is that during the later decades of the last century it became the fashion in certain quarters to regard the British foresters who preceded the expert German foresters, in India, as the "mere amateurs." In my humble opinion, corroborated by that of Anglo-Indian officials of the highest administrative reputation, it was by these "mere amateurs" that the wide and solid foundations of Forest Conservancy were laid deep and fast throughout British India, and notably by Michael and Cleghorn in Madras. These thoroughly practical men prepared the way before them for the specially trained scientific Germans who speedily raised the now regularly organised Forestry Department of the Government of India to its present state of brilliant efficiency, making it the envy of our Imperial Colonies, and the admiration of the civilised world. Cleghorn was a connection by marriage with my family, and I recollect when I was a medical student at Edinburgh, his saying, while there sometime between 1848 and 1852, quoting I fancy from Seneca:—A forest so long in forming may become a waste of ashes in a moment—"Momento fit cinis diu sylva." Considerations of this kind are now leading to the establishment of a Forestry Department under every Government of the civilised world, and the aditial steps in this direction in British India were taken by Michael and Cleghorn. That was their literal, definite, and specific achievement, and is their title to the approbation and praise of their official colleagues and fellow countrymen, and the more this is ignored or gainsaid, the more firmly will it be established in its truth and justice beyond all contemporary cavils.

GEORGE BIRDWOOD.

Empire Day [24th May], 1905.

GENERAL NOTES.

SOUTH AUSTRALIAN PHOTOGRAPHIC SOCIETY.—The annual exhibition of photographic work for the present year will be opened on Monday, 11th September. A bronze medal is offered for competition in each of the nine classes of Section 1, or in lieu thereof the sum of one guinea. A silver medal is offered for competition in each of the eight classes in Section 2. The society offers a gold medal as a champion prize, in lieu of any other prize for the best picture in Sections 1 and 2, such picture to become the property of the South Australian Photographic Society. All exhibits must be delivered at the South Australian Society of Arts' Rooms, Institute, North-terrace, Adelaide, not later than 5 p.m. on Wednesday, August 30, 1905.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 5...Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Messrs. Charles Scott Meik and Walter Boer, "The Improvement of London Traffic."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. R. W. Sindall. "The Manufacture and use of Art Papers." 2. Messrs. Clayton Beadle and Henry P. Stevens. "The Influence of Gelatine Sizing on the Strength of Paper."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Colonel P. H. H. Massy, "Exploring Journies in Asia Minor."

Actuaries, Staples-inn Hall, Holborn, E.C., 5 p.m. Annual Meeting.

TUESDAY, JUNE 6...Royal Institution, Albemarle-street, W., 5 p.m. Rev. Henry G. Woods, "Velasquez." (Lecture III.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 11 a.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Prof. Alleyne Ireland, "The British Empire in the East."

WEDNESDAY, JUNE 7...Geological, Burlington-house, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Miss Josephine Knowles, "Symbolism in Norman Sculpture at Quenington, Gloucestershire."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4 p.m. Annual Meeting.

THURSDAY, JUNE 8...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 5 p.m. Prof. J. A. Fleming, "Electromagnetic Waves." (Lecture III.)

Mathematical, 22, Albemarle-street, W., 5½ p.m.

East India Association, Caxton Hall, Westminster, W.C., 4 p.m. Mr. F. H. Skrine, "Hydrophobia in the East."

FRIDAY, JUNE 9...Royal Institution, Albemarle-street, W., 9 p.m. Sir Wm. White, "Submarine Navigation."

Astronomical, Burlington-house, W., 8 p.m.

SATURDAY, JUNE 10...Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. Savage Landor, "Exploration in the Philippines." (Lecture II.)

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FRIDAY, JUNE 16, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-first Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 28th June, at 4 p.m.

(By Order of the Council),

HENRY TRUEMAN WOOD,
Secretary.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner-circle, Regent's-park, on Tuesday evening, the 4th of July, from 9 to 12 p.m.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club-house will be open.

The Reception, by Sir William Abney, K.C.B., F.R.S., Chairman, and the other Members of the Council, will be held at the entrance to the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

The Tropical House, containing the Giant Water Lily (Victoria Regia), Banana, and other interesting tropical plants, will be open to visitors.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

An Exhibition of Economic Plants, &c., grown in the Gardens of the Royal Botanic Society, together with specimens from that Society's Museum, will be on view in the Corridor.

A collection of Liliums in Pots will also be arranged in the Corridor.

A Selection of Music will be peformed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Grenadier Guards in the Gardens, commencing at 9 o'clock.

Two performances of Selections from Pastoral Plays will be given in the Gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.45 p.m.

A concert and entertainment, including a scene from "The School for Scandal," will be given in the Club-house, from 10 to 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards are now in course of issue. A limited number of tickets will also be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter cf introduction from a member.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, May 18; Sir DENNIS FITZPATRICK, K.C.S.I., in the chair.

The CHAIRMAN said that Dr. Creighton was so well known by his works that he hardly needed an introduction. It might be mentioned, however, that the paper Dr. Creighton was about to read embodied the results of a special journey he took to India for the purpose of studying the external aspects of plague in that country.

The paper read was—

PLAGUE IN INDIA.

By CHARLES CREIGHTON, M.D.

Eight years ago the subject of plague in India was brought before this Society in a paper by Dr. Herbert Birdwood, which dealt with the first epidemic in Bombay city in 1896-97 (*Journal*, Feb. 28, 1898, vol. xlvi. p. 305). Dr. Birdwood's intimate account of the beginnings of the infection, of its rapid extension, and of the efforts made to cope with it, will remain a document of importance, both by reason of the fresh impression of so novel an experience in an Indian city under British rule, and also because it was the first chapter of what is likely to prove a long history. At the date of the paper, a second plague-season in Bombay had begun, which proved to be more disastrous than the first; the cities of Poona and Karachi were also infected severely, and there were many minor centres along the whole coast northwards to Cutch, and in the transmontane districts of Satara and Sholapur to the south, as well as two small spots of plague more than a thousand miles away in the north-west, one around Hurdwar, and the other in villages of the Jullundur doab. By that time the Government of India was naturally alarmed at a threatened invasion of the whole country, and appointed in August, 1898, a Commission of five to conduct an investigation specially defined as of a scientific character, into origins and ways of spreading, as well as into the mode of treatment by serum-inoculation, and the mode of prevention by inoculating a solution of dead bacteria. That Commission is now ancient history; so that I am at liberty to remark, that there was not a single epidemiologist upon it, and that its "scientific character" was ruined by two causes: first, because the two medical members who wrote the Report put aside such evidence as did not come within their bacteriological point of view, and, secondly, because the two departmental members were disinclined to look into the errors or omissions of sanitation which had prepared the way for plague, especially in Bombay city. However, the witnesses contrived to say a good many things, *proprio motu*, which make the three volumes of evidence valuable and interesting reading.

PRESENT AREA.

When the Commission began its work in November, 1898, the centres of infection were many and widely scattered, so that sittings to take evidence were held at places as far apart as Bangalore and Lahore in one direction, Calcutta and Karachi in the other. But the infected area was still comparatively small. There was no plague in the Madras Presidency, none in Bengal excepting at Calcutta, none in the United Provinces excepting over a small part of the district of Saharanpur, and none in the Punjab excepting in one small spot of the Jullundur doab. During the next six years the area has been extended enormously, but still within notable limits. The Madras Presidency has continued almost entirely free, and, what is more remarkable, also the whole of Orissa, Lower Bengal, and Assam. It is the North-Western plains that have become the chosen seat of plague, from the Jhelum river in the north to a point on the Ganges about 300 miles above Calcutta, while the original area in the Bombay Presidency has extended.

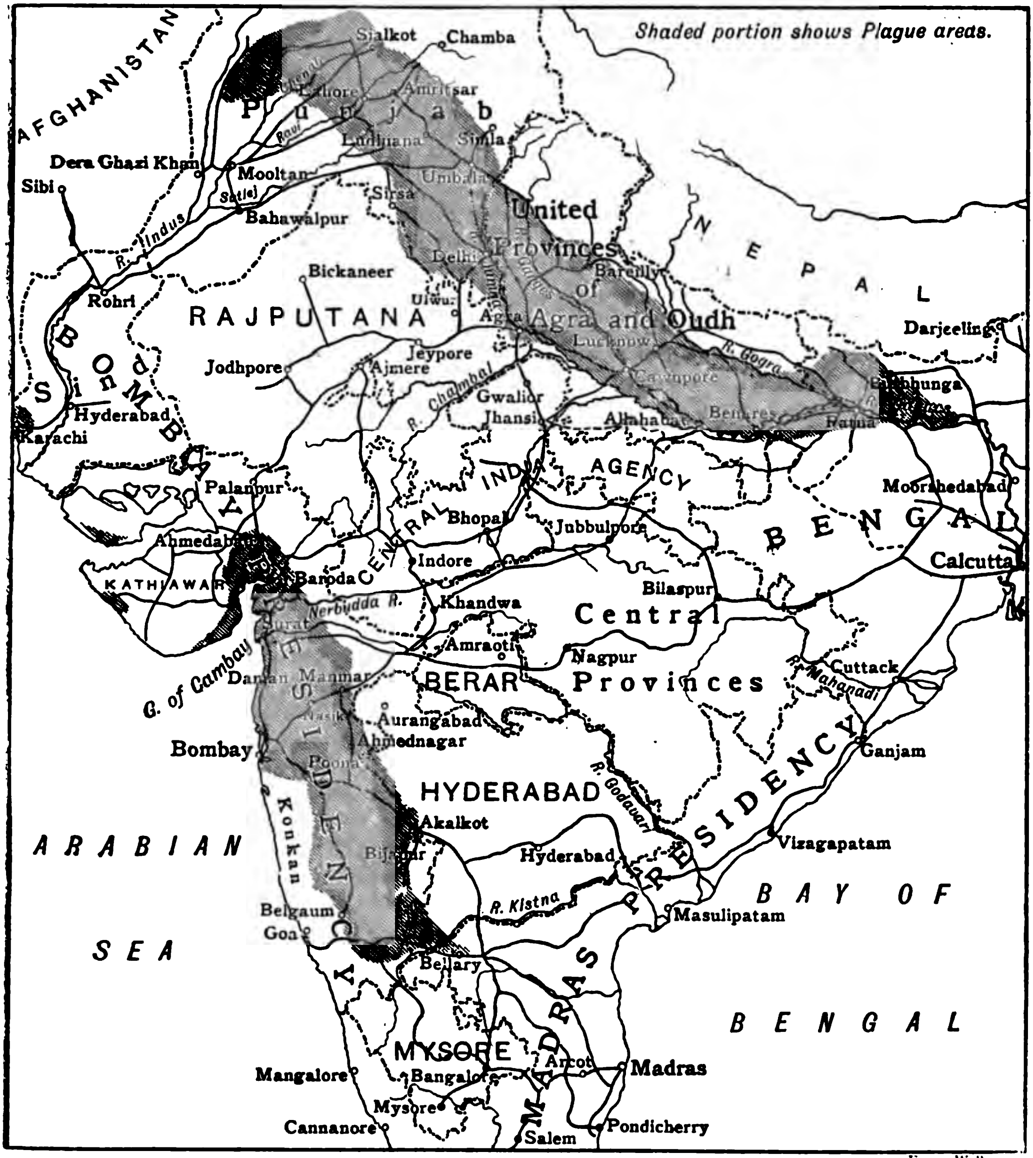
Those regions of India which have been proved by an experience of nine years to be the great seats of plague are shaded on the map. (Fig. 1.) They look somewhat compact and continuous in two divisions—one the plains of the North-West, the other the alluvial valleys of the Deccan and Gujarat. This does not profess to be an exhaustive map of plague. For example, there have been many deaths from first to last in the Native States of Mysore, Hyderabad, Indore, and Rajputana, and in the British Central Provinces, but far more in the cities, such as Bangalore, Indore, and Jubbulpore, than in the villages. Also in Sind, Karachi was not the only place infected at first, although it remains almost the only place now. If I had shaded every one of those extensive and sparsely-populated

tracts of country where plague has even been in those years, I should have produced a confusing, if not a misleading effect. Without being exhaustive, the blue colouring in the map on the wall shows fairly enough where the interest really lies, and it covers those parts of the Bombay Presidency and of the North-West to which I limited myself during a recent tour of three months.

SOME FIGURES.

I do not intend to be statistical, but a few round figures may be given to bear out this colouring of certain regions on the map. First, as to the dark area in the south of the Bombay Presidency. The three districts of Satara, Belgaum and Dharwar, and the Native State of Kolhapur, have each returned an almost equal total of plague deaths during the last

FIG. 1.



MAP OF INDIA SHOWING PLAGUE AREAS.

four years, viz., 120,000, being an average of 30,000 a year for each in a population of about a million. The adjoining district of Bijapur had over 20,000 in each of the two last seasons, while Sholapur and Khandesh have each had one season of 25,000 in the more recent period. But in the Punjab those large annual totals have been exceeded in several districts: Sialkote had 50,000 deaths the season before last, Ludhiana almost the same number three years ago, Gujranwala 30,000 last year and 45,000 the year before, whilst the oldest centres of infection in the Punjab, the adjacent districts of Jullundur and Hoshiarpur have shown a steady increase for three years running, reaching last year to 30,000 plague deaths in the one and 25,000 in the other, with the promise of quite as many this season when the returns are completed. For a single week last year in the end of April or the beginning of May, which is the height of the plague season in the Punjab, four of the districts returned 4,000 each, while half a dozen more returned from 2,000 to 3,000. In the United Provinces until this year no district has come near to those enormous weekly maxima; but at length Muttra has reached 4,000 plague deaths in a week, while Ghazipur and Agra have each had a highest weekly total of about 1,600. In Behar the worst district has been Saran, the poorest and most crowded part of India, which has reached 2,000 a week, while two or three other districts of the same Patna division have had each over 1,000 a week at the height of the plague season. Last year the plague deaths in all India totalled about a million, of which nearly 400,000 came from the villages of the Punjab and 300,000 from the villages of the Bombay Presidency. Last year the worst week was that ending the 2nd of April, with a total of 46,320 plague deaths. This year the week ending 1st April had a total of 57,702, the increase being more than accounted for by the unusual severity of the infection in certain districts of the Agra province, and in the adjoining districts of the Delhi division of the Punjab, as well as by the extension of area eastwards in Behar.

Plague an Old and Well-understood Infection.

To an epidemiologist this enormous prevalence of plague steadily from year to year among the rural population of India is perhaps the most remarkable phenomenon in his science. It is all the more remarkable that we have never thought of India as a great seat of plague in former times, such as Lower Egypt, Syria, and Irak had been during many centuries of Mohammedan rule, and that we were beginning to look upon plague as a thing of the past everywhere. In writing the article on "Quarantine" for the *Encylcopædia Britannica* twenty years ago, I gave nearly all the space to yellow fever and cholera, remarking of plague that "for many years it has ceased to have any practical interest in this connection," although it had been the original object of all the quarantine laws of Europe. And to show that I was not singular, the paragraph on port quarantine in the Bombay Sanitary Commissioner's Report for 1887 has this sentence:—"Plague or yellow fever have never to my knowledge existed in Bombay, and are not in present circumstances ever likely to be there met with" (T. G. Hewlett, l.c. p. 82). The outbreak in Bombay nine years ago was a surprise; but the greatest surprise of all, in a historical sense, has been the endemic settlement of the infection in the plains. This is, indeed, a real novelty of the present situation to epidemiologists, as well as a very serious practical matter; but, for the rest, plague is a very ancient disease, and, I take leave to say, very well known in its type and in its habits to those who are competent in such matters. There is just as little mystery about plague, and just as much, as there is about cholera, or yellow fever, or typhus, or enteric; and there is actually less mystery about it than about those everyday domestic incidents, measles and scarlatina. What then is the meaning of the claptrap about "our ignorance of plague?" So far as I can understand, it has arisen from the fashion of thinking bacterially about diseases, which the public and the newspapers have adopted. Bacteriologists, when asked to explain plague, are found to be not so lucid as usual; they are at fault in the pursuit of the bacillus outside the body; it runs to earth and gets lost in a crowd of other bacteria in the soil, or disguises itself as a saprophytic mould, or perishes outright in the struggle for existence, although there is no doubt about the infection remaining in the ground all the same. Hence, perhaps, the impression that more bacteriology is necessary before anything practical can be done.

Recent Scientific Developments.

As plague is not found to be contagious from person to person except in its pneumonic

variety, everyone sees that the interest must centre in the infection outside the body. In that connection research in India has added only two novelties to the older body of doctrine, both of them of the minor kind. No one can deny, although some would if they could, that the regular way of receiving the infection of plague is by the breath; but inasmuch as rats in a laboratory can be made to take plague, or something like it, by inserting a culture of bacilli at a puncture of the skin, so it is sought to prove that there may be something corresponding in human experience. One theory started in India is that the infection may enter through wounds of the feet, as the people of that country so often uncover their feet ceremonially, and so many of them go barefoot for want of shoes. This theory is of course inapplicable to European plague, for example, the Great Plague of London in 1665. But there is another theory devised to give moral support to the inoculation experiment on rats, which implicates the rat himself; it is, that the fleas which infest the rat may introduce infection through fleabites on the human skin. The Austrian Plague Commission, which was the first in the field at Bombay in 1897, had already considered whether mosquitos might not carry plague infection, for example, in the plague hospital (where they abounded), from a patient to a nurse; but they found that it was not so, although everyone was bitten.

Various other insects were next thought of, and at length the interest has centred in fleas as possible carriers of infection from the rat. Researches of a very minute and technical kind were started by this hypothesis, on the lines of the well-known microscopic researches on mosquitos. Captain Liston has conducted, in India, a large amount of research upon the fleas which infest the rat. The question next arises, whether those are the same species of fleas which produce the human flea-bites; then there is the question whether those who take plague had been bitten by fleas in matter of fact; and, lastly, the question of microbes in the fleas. All this is, no doubt, a very promising field of academic inquiry; and I am given to understand that the scientific expedition which has been announced with a flourish of trumpets as about to proceed to India "to make a thorough investigation into the causes and origin of plague" is really going out to work in the laboratory at Kasauli, with a view to settling all those open questions in the hypothesis of flea-bites.

Plague Localities.

Just as in a well-known paper read before a certain scientific club, "the theory of tittlebats" was joined naturally to their habitat, the Hampstead Ponds, so I would wish to pass, with no abrupt transition, from the bacteriology of plague to the localities of it. Before I started on my recent expedition, I spent several months in getting up the Gazetteers of the districts which I meant to visit, partly to become acquainted with a strange country, and partly to note any facts as to population, poverty, kind of soil, height of ground-water, canal irrigation, rainfall, or the like, which might throw light upon the incidence of plague upon some localities rather than on others. There was probably some reason why the villages of Lower Bengal should have escaped plague absolutely, while those of Behar have had several bad seasons of it, or why the districts of Oudh should have had so much less plague than those of the Agra province, or why the Punjab districts of Hoshiarpur and Gurdaspur have each lost 80,000 by it, but the district of Kangra none, although it has an incessant traffic with them by the old and new Dharmsala roads. But the contrast which seemed, on paper, to be the best worth investigating was that between the Bombay coast districts of Kolaba and Ratnagiri, and the districts across the Ghâts from Satara to Dharwar.

Plague-free Villages of the Konkan.

Take for comparison the district of Ratnagiri and the adjoining district of Satara. The coast district might seem to be in some respects the more liable of the two: it has a denser population; there is a constant traffic of people between it and Bombay city (which is said to contain a hundred thousand natives of Ratnagiri, working-class and middle-class), and it is as much an agricultural district as Satara, with about the same number of village communities and one-third more houses per square mile. Again, in matter of fact, plague has been introduced into the numerous small harbours along the coast dozens of times. But it has never taken hold of the villages, and has been so little indigenous in the coast places that the annual average of deaths for the whole district from first to last has been only 400, while that of Satara for the last four years has been nearly 30,000.

PLAGUE IN TWO ADJOINING DISTRICTS.

RATNAGIRI DISTRICT.		SATARA DISTRICT.
Population 1,105,000		Population 1,225,000
Villages 1,297		Villages 1,329
Persons per sq. mile..270		Persons per sq. mile..240
Year.	Plague deaths	Plague deaths.
1897	305	128
1898	351	12,124
1899	246	8,646
1900	276	7,953
1901	151	182
1902	379	34,583
1903	558	36,826
1904	733	16,169
1905	190	26,275

Clearly there is something in the Ratnagiri villages unfavourable to plague, and something in the Satara villages peculiarly favourable to it. I have visited both, and shall give briefly what I believe to be the relevant points of difference. The Konkan is a rocky region. Looking down upon it, in that magnificent view from one of the "points" of Mahableshwar, one might take it to be a great barren land of red rock; but after descending some miles by the zig-zag mountain road, one comes to patches of cultivation and to scattered hamlets, and at the end of five-and-twenty miles to a large village surrounded by cultivated fields.

The map of the district shows that there are many such villages hidden in the foldings of the hills, and built usually along a stream. My notes relate to a village on the Savitri river, nine miles from the creek of the sea in which it ends. Everything is built of stone. There is an extensive ghât of dressed stone with steps down to a pool of the river. Facing the ghât is the village bazaar, the roadway paved with stone, the houses of one, two or three storeys with stone walls and tiled roofs, raised some four or five feet above the road on plinths of dressed stone, and sometimes with stone steps below the plinths; the houses of the bazaar in a continuous row with doors close together, but the rest of the village more dispersed along the main road and side roads, at one point forming a hamlet, while another part of the village is in scattered houses across the river. The ground-floor rooms are as dark as they usually are in India, with a fire burning on the floor at the far end; the cattle are usually in the house, or in a verandah, but sometimes in a shed of the small compound.

So far as concerned the want of light and air, and the keeping of cattle indoors, these Konkan village houses did not seem to be worse or better than elsewhere. Their masonry construction, their high plinths, and paved roadways, were proper to a region where stone is easily got, and where the heavy monsoon rains — 100 inches average in the year — make durable structure necessary. The other distinctive character of the Konkan villages is the more open order of their houses and small homesteads, which may extend a mile or more

FIG. 2.

VILLAGES OF RATNAGIRI.

along one or both sides of a stream, some villages having only one long, paved street with a row of houses on either side, like many of our own villages. This peculiarity of the Konkan villages can be seen everywhere upon the large-scale maps of the Kolaba and Ratnagiri districts (Fig. 2). On the scale of one inch to the mile, it is possible to show the extent of the village site more accurately than by the conventional dot or small circle of ordinary maps. This lantern slide shows a bit of Ratnagiri district around the head of one of the numerous creeks which run up twenty miles from the sea. It will be observed that the small squares, or rhombs, or other geometrical figures, by which cartographers indicate homesteads or clusters of houses, are peppered all over the surface, so that the houses of one village along a stream almost join on to those of the village above it or below it. Towards the southern end of the district the villages break up definitely into scattered hamlets.

What has been said of Ratnagiri is true equally of the State of Sawantwari adjoining it, which has had only five plague deaths several years ago, besides some fifty deaths among fugitives from neighbouring plague districts. Also the Portuguese territory of Goa, with a far denser country population than any of the British districts to the east of the Ghâts, but scattered in innumerable small clusters of houses or bamboo huts beside their gardens and fruit groves, is reported to have had no plague, although it is in constant communication with Bombay by sea, and with Dharwar and Belgaum by hill roads and the railway.

Plague-stricken Villages East of the Ghats.

Let us now leave this populous coast region, happily free from plague, or almost free, and cross the Ghâts to the eastward. The easiest of the mountain roads is the one that ascends from the coast to the hill station of Mahableshwar, and descends on the eastern side to the Southern Maratha Railway at Wathar, a distance of seventy miles. An hour or two below Mahableshwar one comes in sight of an altogether different kind of country, and a different type of village from those west of the Ghâts. First, there is the upper basin of the Krishna river, with gigantic precipitous sides of red rock and a perfectly flat bottom, shaped liked one of those oval bath tubs that are in common use in India. This lies in the district of Satara and *taluka* of Wai, which was full of plague last cold weather, some of the plague villages being in sight on the flat plain below the carriage road. After passing through the plague-stricken town of Wai, the road continues due east over characteristic Deccan country, which is shown in this lantern slide extracted from the survey map one inch to the mile (Fig. 3). It will be seen that the villages are now large compact squares, at intervals of several miles on a flat ground absolutely bare of intermediate houses or hamlets. In this small piece of map are included villages whose names recur several years in the plague returns. I shall not give particulars of any of these Satara villages, as I have others from districts farther south. But the type is the same in all

Fig. 3.

Villages of Satara.

those black-soil valleys of the Deccan, watered by the Krishna and its numerous affluents. What Sir Thomas More said of the towns of his mediæval Utopia may be said of them:—"Whoso knoweth one of them knoweth them all, they be all so like one to another, as far forth as the nature of the place permitteth." They are all mud villages enclosed within a ring fence of bushes, sometimes with gates and remains of a wall. Many of them are large, with populations up to 4,000 or over, comparatively few of those that recur in the plague lists having their population, as given

Deaths from Plague in Seven Villages near Hubli, from 1898 to 1904.

Pop. in 1891.	Village.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	Total.
3,589	Byahatti	799	36	—	75	229	271	43	1,453
2,203	Ingalhalli	810	—	—	60	186	202	35	1,293
1,306	Bhandiwad	485	22	—	44	1	27	17	596
2,548	Kusugal..	773	84	—	101	123	80	—	1,161
3,915	Unkal	349	98	—	342	261	126	—	1,176
2,713	Hebsur	270	—	—	—	334	155	—	759
1,702	Yarguppi	356	—	—	10	81	125	—	572

on the margin, under four figures. In the first season of plague amongst them, 1898, some villages lost more than a fourth part of their inhabitants in two or three months. Thus the village of Shelwadi, *taluka* of Navalgund, district of Dharwar, with a population of 4,222, had 1,126 plague deaths in eight weeks of October, November, and December. In Table I. (p. 815) I have taken out the figures for a cluster of seven villages in the *taluka* of Hubli, to show the severity of their first plague season, and the extent to which they have suffered in subsequent years.

Two villages which I visited, one twelve miles from Belgaum, the other seven miles from Dharwar, will serve as samples of the large villages in the black-soil basin of the Krishna, each of them having had five epidemics in the course of seven years.

A Belgaum Village.

The Belgaum village was considered a rich one, the bulk of the cultivators being prosperous Lingayats. The population in 1891 had been 4,586, it had an area of 2,600 acres, and it was the cattle-market for the extensive pastures on the hills and downs to the north-west. The 800 houses of the village covered 64 acres, about 600 of them occupied by Lingayats and other castes of Hindus, 200 by Mohammedan butchers and cattle-dealers in a separate quarter. It was enclosed by a ring of bushes, outside which was the invariable mud-hole or so-called tank, with the Hindu burning-ghât and the Mohammedan burial-place on its high bank. The houses stood upon a series of slight elevations and declivities, in fairly wide streets or lanes; they were close together in rows, but there was no extreme congestion. They were nearly all built of mud upon earthen foundations; but some were raised a foot or two on stone plinths, and had a few courses of stone in their walls above the plinths, the stone being procurable from a quarry in a hill three miles distant. As it was the dry season, there was much dust everywhere, and a general look of sordidness, unrelieved by a single amenity excepting an occasional carved doorway and two or three verandahs. Some of the houses had been rebuilt within a few years, one last year, on the old foundations. Some had considerable back yards, very ill kept, but most had no curtilage whatever. Yet in a perambulation of the village site, one met with nothing strikingly offensive to sight or smell.

There had been 147 deaths from plague from August to October, but no new cases for six weeks, and the only evidence of the recent visitation was a number of padlocked doors. This outbreak was the fifth since 1898, and the slightest hitherto. I have compiled from the records the following Table showing the whole history of plague in this village :—

Five Outbreaks of Plague in a Village near Belgaum. (Population 4,586.)

Year.	Worst Months.	Plague Deaths.
1898	June-August	375
1899	August, September	741
1900	—	—
1901	July, August	336
1902	September, October	225
1903	—	—
1904	August, September	147
	Total	1824

The enormous loss of life in 1899, over seven hundred, was felt in the census of 1901, which showed a great reduction from that of 1891, and the aggregate loss of two-fifths of the population in seven years must have left a good many houses empty. I examined only two of these, in which there had been deaths a few weeks before. They were both old and crumbling, built of sheer mud, without plinths, standing side to side on a slight declivity of the main street. Each consisted of a single square room, without window or back door, with an oil-mill occupying the centre of the worn earthen floor, the occupants of both having been oilmen. The party wall between them was of mud, only six or seven feet high and crumbling at the top, so that the houses were open to each other across the whole pitch of the begrimed roof. Plague deaths had occurred in both, and in one of them five had died out of a family of six. There were several other padlocked doors on the opposite side of the street, and at intervals in the rows of houses elsewhere. Most of the houses, I was told, had been visited in one or other of the five epidemics, those which escaped in one season being invaded in another; whilst some houses had had the infection in them time after time.

While the infection had crept about to all parts of this village site, it was the unanimous opinion that it always began in a certain quarter, the high ground on the northern side, next to the high road, which was the

particular quarter of the Mohammedan butchers and cattle-dealers. The Lingayat cultivators had a bitter grievance against their Mussulman neighbours, which they tried to interest me in, having mistaken me for a person of authority. Slaughtering of cattle, sheep and goats, curing of meat for the Bombay market, dressing of hides, and the like, were the chief industry of that quarter of the village. There was no regular slaughter-house, but each householder used his house or the space before or behind it, for killing in, the flayed carcases and skins being in evidence as one walked past; and of course the whole soil of this elevated corner of the village was saturated with the blood and offal of many years and swarmed with rats, as shambles always do. A year or two before, the sanitary inspector from Belgaum, a native official of the third rank, had made a report upon the nuisance, recommending that the Mohammedans should be removed to a new site outside the village, which could have been found for them with the greatest ease not far off; but the Commissioner had not moved in the matter, and the anger of the Lingayat farmers was unappeased.

A Dharwar Village.

I shall take next a somewhat different sample of these villages, which also has had five epidemics of plague in the last seven years, but not so severe, and curiously enough always three or four months later in the season, as this Table shows:—

Five Outbreaks of Plague in a Village near Dharwar. (Population 4,661.)

Year.	Worst Months.	Plague Deaths.
1898	Dec.	101
1899	—	—
1900–1.. ..	Jan., Feb.	229
1901–2.. ..	—	—
1902–3.. ..	Jan , Feb.	175
1903–4.. ..	March	185
1904–5.. ..	Jan.	32
		722

This village was a purely agricultural one, with no cattle trade; which is the common type on the rich black plain, or *desh*, extending eastwards from Dharwar. The road all the way from the city passed through an unbroken expanse of wheat, jowar, and cotton, many of the wheat fields being of 20 acres. The area of the village in question was about 2,000 acres, but much of it was in the hands of a few large farmers. The patel of the village, a headman in stature as well as in name, farmed 100 acres, another resident farmed 200, and several who were resident in Dharwar city were also large owners and occupiers. About a fourth part of the villagers were labourers who held no land, many having lost it by mortgaging to the wealthier villagers, or to pleaders in Dharwar, who had thus acquired their large farms. The village had once been defended by a wall, and still retained two gates. Although it contained a number of well-to-do farmers, it did not contain a single *pakka* dwelling-house. The houses were all of mud, many of them raised about a foot above the road on plinths of stone, which was got from a hill overlooking the village on the north. There was only one masonry structure —a variegated marble hall with open top galleries, for public meetings, which had been built recently by subscription. The streets or lanes were fairly wide, unpaved, and deep in dust. Few of the houses had verandahs, and they were all equally common or mean. The usual ground plan was three rooms, one behind the other, with a back door opposite to the street door, but without windows, the cattle being kept in the apartment next the street. All round the backs of the houses ran a space which was enclosed in places, traversed by not over-clean footpaths, and overgrown with bushes; but in the dry weather it was not notably filthy, and there appeared to be no particular need for what is called village sanitation; at least one did not see where the sanitation was to begin, so long as the streets were unpaved, and the whole village, except the marble hall, built of mud. At the date of my visit in December, the fifth epidemic of plague had only just begun, but it appears from the subsequent printed returns that fourteen died of plague in December and eighteen in January, while a continuance until March was probable, according to precedent.

Plague-villages of the North-West.

Time will not allow me to describe in detail other plague villages, and I regret especially that I must pass over the much better type of village in Gujarat, in which the houses are mostly built of brick (but sometimes repaired with mud), raised on plinths, commodious, and not without traces of taste. Leaving the Bombay Presidency, and coming next to the

North-West, which is now by far the worst seat of plague, the many thousands of villages which have had the infection in them are of a very uniform type. As one goes westwards, the compact fort-like aggregate of mud walls and flat roofs becomes more distinctive, and throughout the whole of the Punjab that is the type. We have left behind the more open and irregular formation of the small Bengali village, with clumps of trees or bushes between the several homesteads, patches of kitchen garden among the trees, and creepers overrunning the verandahs. High pitched tiled roofs succeed, and after these thatched roofs with broad drooping eaves, until at length we come west of Allahabad to the naked mud walls and flat roofs of the North-West, without a single amenity that the eye can rest on, and in many cases without even a tree beside the village well. The interior of these villages is not unlike that which I have already described for districts of the south, but the houses are often huddled together, with narrow winding lanes between the rows, and sometimes in compact blocks, back to back and side to side, with no intervals at all. I shall take an extreme instance from a large and wealthy village of Jullundur. Jullundur is one of the most fortunately situated districts of the Punjab, and its villagers are proverbially well satisfied with their lot in life. They have a soil renowned for its fertility, and they have water so easily reached by wells wherever they may sink them, that they can dispense with irrigation canals, and need not pay two or three rupees an acre for watering their crops. If they are poor it is because the pressure of population is great, being indeed about 600 to the square mile, and the highest in the Punjab; but the signs of poverty, or at all events of distress, are not at all obvious to the passer-by, and the people are of good physique. The district was the first in the Punjab to be infected with plague, and in the last four years it has lost 100,000 by that cause; at the time of my visit, those who were dying were said to be robust men and women in the flower of their age.

A Plague-village of Jullundur.

The particular village which I am about to describe had a past history of plague, but I am unable to give it, as the Punjab Government does not tabulate and print its returns from villages, as the Bombay Government has done from the beginning. Its population was about 3,000, and it had lost about 250 by plague in the months of March and April preceding (1904). The greater number of those deaths had come from a square block of houses (and from one or more like it) which had the most remarkable construction that I saw anywhere in India. It was literally a hive of some thirty or forty mud cells. A narrow passage ran round the square, with doors at intervals in the dead wall. Entering by a door near a corner of the square, one came into a room, which somehow held a cow or bullock as well as the family, and had a hatch-like opening in the flat roof with a ladder to ascend by. On reaching the roof one found that it was a continuous expanse of thirty or forty small squares like those of a chess-board, marked off from each other only by ridges of mud, which one had to step across in walking a distance of some thirty or forty yards to descend by another ladder at the opposite corner. Each of the thirty or forty square roofs had a round hole in the middle, invariably covered by an earthenware cap like an inverted flowerpot. Close to this mud block, separated from it only by the six-foot passage, was a group of ten or fifteen brick houses two and three storeys high, with windows, balconies, and the usual features of the *pakka* houses of towns; this was the only masonry quarter of the village, holding about a twentieth of the population. I could not learn whether its residents had escaped altogether the infection which was so violent in the mud block next to it, but it was certain that most of the plague cases had been in the latter, or in another like it, some cells being pointed out in which as many as four persons had died. Most or all of the apartments were now retenanted, and there had been no sign of a revival of the infection down to the middle of January last. In another village, at the other end of Jullundur district, I mounted the roof of a block of houses in the Mohammedan quarter, thinking to find a continuous expanse like the former; but in that instance there were cattle-pens and one or two alleys in the midst of it.

Plague in the New Villages of the Chenab Colony.

Having been told that the new regulation villages of the Chenab and Jhelum colonies had had plague in them equally with the old Punjab villages, which was not at all what one would have expected in recently occupied sites, I visited both colonies to see how the matter really stood. I found from the printed figures

of 1904, that the district of Jhang, which included fully three-fourths of the Chenab colony (now the Lyallpur district) had had 4,000 deaths from plague, nearly all in April and May, 1904, which was only a tithe of the rate of other Punjab districts equally populous; and that the southern tahsil of Gujranwala, which included the rest of the new Chenab villages, had had far less plague than the three other tahsils, where the villages were old. Still, there had been plague in the new villages, one of those which I visited having had thirty deaths in the month of December, 1903, with a prospect of more if the villagers had not cleared out into the jungle, and another near it, but built two years earlier, before the regulation plan was adopted, having had sixty deaths. There are more than a thousand such new villages in the Chenab colony, which have been built within the last twelve or thirteen years. The colonists are in great part retired sepoys of the Sikh regiments, with their *subadars*, or native officers, as the lumbardars of villages. Sepoys received grants of 18 acres, some officers a square of 28 acres, others two such squares, paying a small land tax, as well as so much per acre for the use of the canal water for irrigating their fields. The land is now nearly all taken up, and is producing heavy crops of wheat, cotton, and sugar, the export of wheat from this district being one of the largest from India, as the railway traffic showed.

The regulation village which I visited, about six miles across country from the railway, was a great improvement in some respects upon the ordinary hugger mugger of an old Punjabi village. It was laid out in regular squares with wide roads between; the compounds were roomy, with the dwelling-houses kept apart from the cattle sheds; a certain elevation had been prescribed for all dwelling-houses, perhaps ten feet or more, just as our own Local Boards have raised the height of all new country cottages. But the Public Works Department had left the colonists a free hand in the matter of building materials, and they had built their villages of sheer mud. In the village I am referring to there was not a single kiln-burnt brick except in the facing of the village well, and, so far as I could see, there were not even sun-dried bricks in the walls of houses. The whole village was a hasty pudding of crude mud walls, some of which were already cracked. When I asked to see some house in which there had been plague I was shown a closed door a few feet behind the chair of state in which I was seated at the cross-roads of the village; it was a small corner house or shop, apparently a single room without a window, in which two cooks had died of plague; the mud wall was cracked in places, and had one or two round-holes in it which looked suspiciously like rat holes. All the new villages of the colony are built of mud, except those few which have the good fortune to be stations on the railway.

Plague in the Old Villages of Shahpur.

The other irrigation colony, between the Chenab and the Jhelum rivers, is now being planted throughout the jungle of Shahpur district, following the lines of the Jhelum Canal. Last year Shahpur had the enormous mortality of 33,000 from plague among 470,000 people, most of it in the time of the wheat harvest. I suppose that some small part of it occurred in the new villages, but if the instances which I saw were fair samples, most of it must have come from old villages, of which there are many within the valley of the Jhelum, depending, as of old, on wells and on the rainfall for their harvests. The three villages which I saw at close quarters were within a few miles of each other, all raised conspicuously above the dead level of the plain on conical mounds of black earth. Their mud houses covered the sides and summit of these mounds, which were doubtless formed by the *débris* of former villages upon the same site, and may have been growing by accretions of rubbish ever since the time when Alexander overthrew Porus on a battlefield not many miles distant. They looked the filthiest and most dilapidated villages that I had seen anywhere, and were credibly said to be swarming with rats. Each of them had lost about a fourth part of the population by plague the year before.

Before I leave the villages, which have nine-tenths of all the practical interest for plague, I will give a few minutes to two questions about them. First, is there any real need or excuse for all this mud building? and, secondly, are the large, compact, fort-like villages necessary and likely to continue?

Mud Walls.

First, as to the almost universal mud walls and roofs in the North-West. In the Punjab districts which suffer the extremes of heat and cold, the excuse is made that mud walls are the coolest in the hot weather and the warmest in the cold. But the more general explana-

tion is undoubtedly the ease and small cost with which mud houses can be run up. On that point I may be permitted to quote a few sentences by the late Mr. Frederick Growse, who gave much attention to Indian architecture, and did much to revive the native building arts in his Collectorate of Bulandshar :—

Replying to a circular of the year 1888 on the question of village sanitation, he wrote :—

"Under such supervision, an ordinary Indian village would in the course of a few years be less repulsive in appearance than it is at present, but I doubt whether the death-returns would be materially reduced. . . . The real scourge of the country is fever. This is felt all the year round, and will continue to be so until the people adopt a more rational style of house-building. At present the ordinary mode of procedure is to dig a pit, and with the clay extracted from it to raise a wall on its margin and roof it over for a habitation, the floor either remaining several feet below the surface of the ground outside, or being partly filled up with the first rubbish that comes to hand. . . . In no country, however barbarous, is such a style of building in vogue. It has been adopted in these provinces on account of the tenacity of the ordinary clay soil, which thus lends itself readily to the purpose. But if in other countries, where poverty is as much felt as in India, building materials have invariably to be brought from a distance, the same necessity should be recognised here."

Again, referring to the district of Fatehpur, he says :—

"Thus, for want of skilled labour, the villages are all exceptionally mean-looking collections of mud hovels; and the towns which sprang up under the Oudh Nawabs are all in decay. . . . . . . If the standard of living is low, it is more so from habit than from absolute lack of means; large sums are yearly expended on the only public works which a Hindu ordinarily recognises, namely, temples and bathing-tanks."

The alluvium of the whole North-West makes a sufficiently tenacious clay, and the black soil of the Deccan valleys is even more sticky. The former can easily be burnt into bricks, while there is always red soil suited for brick-making, or a stone quarry, at no great distance from the black cotton soil. When I asked the lumbardar of one of the new villages in the Chenab colony, "Why do you not have *pakka* houses?" he answered, "We are very poor men." But, as Mr. Growse said, the poor standard of living is more from habit than absolute lack of means; other countries, where poverty is as much felt as in India (and more felt than in the Chenab colony), employ village masons and carpenters, and they have shown their progress in well-being first of all in the improved housing of the peasantry. This has been the recognised test in Ireland in the last fifty years, and in Scotland the great advance in the latter part of the eighteenth century was shown in nothing so much as the disappearance of such "auld clay biggins" as Burns was born in. Yet in India mud villages have entered on a new lease, under the auspices of the Public Works Department.

Sanitary Advantages of Hamlets.

As to the large, compact, fort-like villages which are peculiarly the seats of plague infection. It passes as an axiom in India that small villages and hamlets may be almost left to take care of themselves in a sanitary respect. The axiom is embodied in the Government Revenue Handbook, and it recurs time after time in the replies to two circulars on village sanitation issued in 1888 and 1893. What was thus obvious in times of cholera is not less obvious in the present time of plague. The advantages of hamlets are even more marked in the latter, for the Bheels of Western Khandesh, who were among the chief victims of cholera in the last famine, are said never to have plague in their rude hamlets or moveable camps, although the infection has been disastrous in the settled villages of Eastern Khandesh. The same escape from plague of small and moveable hamlets was remarked by Colvill in his tour through the plague districts of Mesopotamia in 1874. The trouble always and everywhere has been from crowded sites too long inhabited without drainage. The more compact the site, or the greater the congestion of houses upon it, the more will the soil be filled with organic impurities. It is well known that soil has the property of breaking up organic matters by oxidation and nitrification, that it filters off and retains organic substances suspended or dissolved in water, arrests the action of ferments, and retains bacteria in its upper layers. But if the upper stratum be saturated with organic matters beyond the power of the soil to enter into combination with them, each new accretion sinks down more or less slowly to the deeper layers unchanged, there to undergo putrefaction or reduction by ferments, so that beyond a certain point the self-cleansing action of the soil breaks down. The limit of endurance is passed constantly in old inhabited sites, whereas in fields pastured by cattle or sheep, or manured for cropping, the

wholesome chemistry of the soil goes on from season to season without check. That the infection of plague resides in the ground is now accepted by every practical man in India who has been on plague duty, and is perceived intuitively by the people themselves.

Centre of Plague in Oudh.

Such being the correct scientific theory of plague, one may find in it one reason why those parts of India which have the rural population least congested in particular spots should have had little plague or none. I have given the instance of the Konkan somewhat fully, and have a few remarks to make about Oudh. The Oudh landscape is always pleasing. There are other provinces, such as Gujarat, which may dispute with Oudh the title to be the Garden of India, but it is certainly the garden of the north-western plains. It is the province of hamlets or small villages, and of a resident nobility and gentry. Plague has not been absent from Oudh; for, two or three of the districts in the south and east, along the Ganges, have had large mortalities. As the Government of the United Provinces does not print full details of the villages infected with plague, one has to find out by personal inquiry, and I was advised to choose Fyzabad as a characteristic part of Oudh. In the week before, that district had returned 110 deaths from plague; and the question was, What kind of villages did these come from? One of the four *tahsils* of the district had to be taken as a sample, and the Fyzabad *tahsil* was the most convenient. It appeared that a full half of all the plague deaths in it were being returned by one village, ten miles from the city, which I went to see accompanied by the tahsildar. It was a large market village of over 4,000 people and 700 houses, with very little agriculture (chiefly sugar-cane) and much cattle trade, more than half the population being Mohammedans. The Sanitary Inspection Book, one of those ordered by Government circular of 1893 to be kept in large villages, contained at various dates severe strictures upon the squalid condition especially of two of its nine *mahallas*, and remarks on the slaughtering of cattle by certain butchers in their houses, and on the common practice of killing sheep and goats in dwelling-houses. There had been plague in it two years ago, and at the time of our visit one whole quarter of the village was evacuated, owing to dead rats having been found and to plague cases thereafter. This quarter consisted of the same two *mahallas* which had been censured as specially squalid long before plague appeared. There had been 65 deaths so far, and two fresh cases that day. The other chief centre of plague in the *tahsil* was also a large market village, with a population chiefly Mohammedan. A few other villages had been returning plague deaths, but none of them more than ten in all, and it did not appear that any of the hamlets had plague. The largest purely agricultural village, with 1,600 people and 2,400 acres, of which fully half were cultivated, was distributed in ten hamlets, and had no plague. On an average the Oudh districts have had hardly more than a third as much plague per head of population as the districts of the Agra province, a ratio which is inversely as the number of hamlets and is most probably dependent thereon.

Hamlets v. Large Villages.

Are there any reasons why the more wholesome kind of country life which is found in Oudh should not be extended to other parts of the North-West? I quote a few sentences to show that the plan or type of large compact villages is neither ancient nor immovably fixed even now. In the "Gazetteer" of Muzaffarnagar it is stated:—

"When Sikh, Rohilla, Gujar, and Marhatta together, or in turn, ravaged the district, no small community could exist, and the settlers fell back on the strong villages from which they had gone forth. After the final pacification in 1805, colonies were again sent out, but so gradually that the beginning of not a few flourishing villages is still remembered."

Again, as to the tendency to return to hamlets, and their sanitary advantages, Mr. Adams, formerly collector of Benares, wrote in 1888:—

"The Sanitary Commissioner has not, I think, taken note of the manner in which, in many parts of these provinces, the villages are splitting up. The villagers in old days clustered together for mutual protection, but now they find they can live close to their fields, and hamlets have sprung up all over the country."

But they are not springing up in the black soil valleys of the Deccan, nor in the Punjab, except in cases of feud between one part of a village and another; and it will appear from what I am about to read, from the pen of Mr. Alan Cadell, that there are reasons why the large villages should remain large:—

"The crowding of the population into large villages," he writes, "is to a certain extent disadvantageous, but the power which the large cultivat-

ing communities have acquired from their numbers and their wealth is of great service to them in resisting the encroachments of the landlords; and the people must feel that they would lose in unity and defensive power if they were scattered over several hamlets instead of being collected together in the old ancestral village. The fact, too, that nearly all the best land is held by occupancy tenants, whose fields are situated all over two and even three estates, makes it still more unlikely that any large number of tenants will leave their present dwellings, for to do so would, while bringing them nearer some fields, take them away farther than before from others, and to effect changes of hereditary fields is always difficult and generally impossible."

Plague in the Cities.

The circumstances of Bombay are so special, if not unique, that it would take a whole hour to discuss them. Therefore I shall not begin upon them, however inviting the theme. Poona, infected from Bombay, has had severe plague every season for nine years, and more of it per head of population than Bombay itself; the sanitary problem is complex there also, and cannot even be stated in a sentence or two. Karachi and Calcutta I did not visit. I will come to Benares, as a good sample of the North-Western cities.

Benares.

The *mahallas* or wards into which Benares is divided fall into two classes—the *pakka*, or masonry mahals, and the *kaccha*, or mud mahals. The separation of the two is sharper, I believe, than in any other Indian city, and will be readily understood from the situation of the masonry mahals. They are that famous range of houses, temples, and terraces which crowns the high bank of the Ganges for a space of nearly two miles. Some fifty or sixty thousand of the population are housed there, and twice as many more in the *kaccha* or mud-built suburbs which extend back from the river-side quarter over a radius of two or three miles. These *kaccha* mahals, however, are not all equally mean in construction; for example, the road, three miles long, which runs from near the cantonment to the railway-bridge over the Ganges, is lined on both sides all the way with houses or shops of brick raised on plinths. The *pakka* mahals along the river are built of stone, which had been brought some twenty miles down the Ganges, from the extensive quarries near Mirzapur. There are no carriage-ways through this region, but only a maze of narrow alleys, with houses on either hand three or four storeys high, and innumerable temples—a perfect rabbit-warren, like the Closes of the High Street, Canongate, and Cowgate of Old Edinburgh. What strikes one most in the not unexciting passage through this maze is the solidity and durability of the structure everywhere. The walls are of stone, the courtyards and floors are paved with stone, the alleys are laid crosswise with long slabs of stone, which form at the same time the roofs of a network of sewers. In this dense mass of humanity, constantly mixing with pilgrims from all parts of India, there has been hardly any plague. I make this statement on the authority of the police inspector who accompanied me, as well as of the Collector, Mr. Radice, who wrote as follows:—"In the five years we have had plague (this is the fifth) the *pakka* mahals have been almost entirely free;" and in the sketch plan showing the incidence of the infection on the several quarters of the city, which he was good enough to make for me, he has marked only one small spot in the riverside quarter, the Gaighat, which had some plague in 1903. On the other hand, the mud-built suburbs and the villages to the west of the city, have had much plague; for example, this year a maximum of nearly 400 deaths in a week in March. In driving through them one could tell at a glance where the plague was likely to have been; thus, on the way from the cantonment to the city, a certain dip in the road is lined on both sides with mud houses of exceptionally mean appearance, which is found, on reference to the plan, to be the Tiliabagh, marked as having had plague "every year."

Cities of the North-West.

In all the other cities of the North-West, which have had much plague, there are extensive quarters of mud-built houses—in Allahabad, Cawnpore, Agra, Lucknow, Bareilly. In Lucknow, beautified as it is with palaces and fine houses, the relative extent of the *kaccha* mahals seemed to be enormous, and the mud walls of so dusty and friable a kind that the heavy rain of December had been breaking them down. Lucknow this year has had up to 480 plague-deaths in a week, a ratio higher than Bombay. I shall give a single illustration of plague in Agra. One of the patients in the plague hospital, a convalescent, was a little girl, the sole survivor of a plague-stricken family of nine. On proceeding with the assistant medical officer to see the house where this tragedy had happened, we found it

to be a dilapidated and abandoned mud hut, one of a compact group of three standing at the road side on the edge of a small pit from which the earth to build them had doubtless been dug.

The three large cities of the Punjab, Delhi, Amritsar and Lahore, have had remarkably little plague. Delhi, which is situated in a stony region, appeared to be nearly all *pakka* built, with the exception of a few lanes around a celebrated Black Mosque of the fourteenth century; and even the villages round Delhi are built of a kind of conglomerate of stone and clay. Amritsar also is a well-built brick city, and in Lahore there are no such extensive quarters of mud-built houses as in Allahabad and Lucknow. The smaller towns and market villages have in some instances furnished a large part of all the plague deaths credited to a rural area. I was told by the Civil Surgeon at Ghazipur that the largest totals in his district this year were coming in from certain towns or market centres which had a considerable Mohammedan population; and in the district of Muttra I saw for myself two such market towns with much plague in them, one of them, population of 9,000, having had 400 deaths in the four weeks preceding, and a maximum of 25 the day before, while the other, with a population of 6,000, had 19 new cases reported that morning. It is the melancholy fate of those old country towns of the Mohammedan period, originally well built, with brick houses and paved streets, and in some cases with fine sarais or forts, to have fallen into decay of trade and dilapidation of buildings, the houses often "*pakka* without but *kaccha* within," as explained to me of an old two-storied brick house at a village near Benares, in which the rats had been found dead and, two or three weeks after, the whole of the inmates, to the number of eighteen, had died.

Means of Avoiding Plague : Evacuation.

According to everyone's belief and experience in India there is only one thing to be done when plague appears in a place, or the rats begin to fall, namely, to clear out, or at all events, to avoid spending the night there. Hence the strange spectacle every evening about sunset, in the city of Bijapur, of the whole population, save the inmates of half-a-dozen bungalows, to the number of some 20,000, quitting the bazaars, workshops and offices, and making their way outside the walls to a large camp on the downs around the railway station. This phenomenon is the more suggestive at Bijapur, as the city was deserted once before, 200 years ago, and most probably for the same reason as now, namely, plague, and continued to be in great part deserted until it was made the administrative head-quarters of the district about 30 years ago. Also in the country round Bijapur the people have learned the lesson of evacuation very thoroughly. I went through an old fortified village of 3,000 people five miles to the west of it, without finding a living creature: the streets were deserted, and the doors of all the houses padlocked, the whole of the inhabitants being in camp near their fields about a quarter of a mile away. They had taken alarm from the number of dead rats found, and the deaths of 36 persons in October, November, and December, and from the recollection of their first plague epidemic two years before, when 171 died in the village. At Bijapur city, I was told by a high native official that, if the infection became active another year, the temporary camp round the railway station would become a permanent residential suburb, so that the area within the walls would be deserted for the second time in its history. This evacuation is at the people's own initiative and at their own expense, which many of them can ill afford. The same thing was going on at Belgaum, where several thousands went out to camp in the evening and returned to their work in the bazaars and offices in the morning.

At Dharwar a small beginning had been made towards permanent evacuation. The Government had given a piece of vacant ground to the municipality, which had sold it by auction in lots at a very low price, and a new street of some forty houses, called Gibb-street, after the Collector, had been run up. At Poona 7,000 or more were in camp along the sides of suburban roads, or on the various maidans of the city. At Bombay there were three large health camps along the seaward side of the island as far north as Mahim. In a group of villages of the Baroda State near Naosari, the cultivators had built lofty and commodious huts near their wells and fields, to which they had removed their bedsteads, chests, and other furniture, and in which they and their children and their bullocks were not unhappy. The weather after the rains is so fine throughout the Bombay Presidency that there is no hardship whatever in camping out.

It is otherwise in the greater part of the plague-season of the North-West, of which I

shall give a single instance from the Punjab. I went one day with the medical officer on plague duty to a group of villages twelve or fourteen miles from Jullundur. At one of these, a small village of some two hundred people, there had been many deaths from plague two years before, and on the day of our visit there were more persons lying sick or recovering in their houses than I had seen anywhere in so small a space except in the hospital at Bombay. After we had gone round the village, a palaver was held with about a dozen of the men and youths, who stood in a semicircle near the village well, the women drawing water all the while. Their spokesman was a sturdy little Jat who knew his mind, spoke to the point, and bore himself with the aplomb of a man of affairs. They had been asked in advance to consider whether they would not submit to inoculation, and had decided so peremptorily in the negative that the matter was not so much as mentioned again. The only question discussed was evacuation. The spokesman pointed out various practical difficulties in the way of a general camping out, to which Captain Bradley replied; and at length it came to this, that the whole village might remove to a camp on a certain piece of waste ground within sight of where we stood, if some help were forthcoming for the poorer villagers; it was all a question of expense, and as I was again mistaken for the Commissioner, I was looked at in a significant way as we took our leave. But to show how many are the difficulties in the Punjab, next day a storm of wind and rain broke, which lasted thirty-six hours, and was followed by two or three weeks of intense cold. Camping out was of course impossible, and the effects of the cold snap were seen in the abrupt rise of the plague figures about a fortnight after from all parts of the Punjab and the United Provinces.

Scientific Theory of Evacuation.

Evacuation of plague-infected houses or village sites had been adopted by the people themselves, without any scientific advice, before the present plague; for example, by the hillmen in Kumaun, and by the Marwaris, who, as White reported in 1836, "instantly quitted a house on seeing a dead rat." The rats themselves, although in India they are the symbols of sagacity, are usually surprised by the underground venom, and are often seen trying to escape in a state of delirium. A scientific explanation of the common practice may be found, first, by including plague fully and frankly among the soil poisons, as I did in my "History of Epidemics in Britain," fourteen years ago, and, secondly, by applying to it the laws of soil-infection which have been worked out by Pettenkofer and his school. An infection of the soil makes itself felt most inside dwelling-houses, and most of all overnight, because there is a natural movement of the ground-air towards the walled space. This was shown by the fact that an escape of gas from a main in the street would travel horizontally through the pores of the ground towards the house opposite, and be sucked up into it, sometimes to the danger of the inmates. von Fodor observed the stratum of air next the floor of an unoccupied cellar at Buda Pesth day and night for a whole year, and found that it always contained more carbonic acid than the ground-air outside, having attracted it from the soil around. In disused cellars, vaults, or covered wells, the accumulation of carbonic acid is sometimes so great as to asphyxiate those who enter them first. One reason for the ground-air streaming to and rising through the basement or floor of a house is that the ground beneath is drier and more permeable, affording a free upward passage unless there be a concrete foundation, or a masonry plinth, or stone paving. Another reason is, that the air inside a house is warmer and lighter, so that it yields to the pressure of colder and heavier air outside and is thrown into an ascending current. The penetration of the house by ground-air is a peculiar risk in India for several reasons. Where the walls are of mud, as they are in the great majority of plague-villages, and have no masonry plinth to rest upon, their porous substance is really a part of the soil, so that the inmates have the ground-air not only rising from the floor but carried up in the walls as if in a ventilating shaft. A dwelling-house warmed all day by the sun, and by the fire kept up for cooking, becomes like an exhausted receiver for the ground-air to rise into. If you visit the old chawls at Bombay, in which there has been so much plague, you will find the narrow dark rooms on the ground floor to be heated like an oven even at eight in the morning.

The intuitive perceptions of the people correspond with the scientific theory of a soil-poison. They know that the chief risk of taking plague is from spending the night in an infected place; and generally that they incur the greatest risk when confined most to the dwelling-houses by cold, domestic duties,

or other cause. One very important thing I must pass over for want of time, namely, the injurious effect of a high level of the ground water, and of its seasonal fluctuations, in a filth-sodden soil. In the new chawls at Bombay, built by the Improvement Trust, nothing seemed to me to promise more for the future health than the solid masonry of the foundations, floors and passages. The advantages of concrete foundations have been proved often in similar circumstances.

PROBABLE FUTURE OF PLAGUE IN INDIA.

I come lastly to the question—Is there anything to be learned as to its probable duration from historical precedents and from its own course during nine years? One was sometimes asked whether the natural time for plague in India to last was not seven or eight years. The origin of the idea is what is recorded of two former plagues in India—one in the reign of the Emperor Jehangir, 1616, of which it is said that "it continued to devastate the country for eight years;" the other in the reign of Aurungzeb, 1688, which "lasted seven or eight years." Each of these epidemics of bubonic plague is authenticated twice over by good contemporary authorities, along with some interesting particulars which I have no time to quote. The earlier of the two began in the Punjab at Lahore, and "destroyed many villages and parganas;" the later, seventy years after, was felt most in October and November, 1688, in the city of Bijapur, which Aurungzeb had just captured, and in which his army was encamped, including 15,000 cavalry; but it is said to have lasted seven or eight years and to have extended over the Deccan and as far as Ahmedabad and Surat. The next outbreak in India fell to be described by three British writers; it happened in Cutch and Kathiawar from 1815 to 1821, in peculiar circumstances of aggravation within walled towns, arising out of famine and the mode of collecting the tribute from the recalcitrant petty chieftains of those territories by the army of the Gaekwar; and it came to an end almost coincidently with the new order of things in 1821. The only other epidemic before the present was also a limited one, in Marwar, especially in the town of Pali, which lasted from 1836 to 1839, and may have been a revival of plague which is said to have been indigenous in Marwar "from a remote period."

Turning from those Indian precedents to the much more continuous and extensive plagues of Europe, we find an uninterrupted history in one country or another, and in one city or another, for more than three hundred years—from the year 1347 to the latter half of the seventeenth century, when the infection disappeared almost simultaneously from all the countries of Western Europe. The chief difference between the European plague-period and the one which is now running its course in India is that the former did not involve the villages, but only the towns, except in its first great wave, from 1347 to 1350, which swamped country and town alike with an almost unheard-of mortality, and excepting, perhaps, two or three general but minor revivals at intervals in the latter half of the fourteenth century; for the rest, it continued an infection of the towns, and in these it commonly broke out at long intervals, twenty or forty years, excepting in such capitals as London, where it was seldom dormant for a series of years until it was about to cease altogether.

It is not surprising that plague in India should be chiefly an affair of the villages, because that has been also the experience with cholera. So much was that a village infection that Anglo-Indian writers who were at home when cholera reached this country in 1831 prophesied that it would fall most upon the enormously congested rural population of Ireland. But it spared the Irish villages and hamlets almost absolutely although it attacked the Irish cities severely. European precedents being thus inapplicable to India as to villages, we are thrown back upon the lessons that may be learned from the history of plague in India itself during the last nine years. It is only from the Bombay Presidency that we have data minute enough to be of much use; from which it appears that the huge totals of plague deaths year after year are not so hopeless as they look. When they are analysed—and it is no small labour to analyse them—it is found that the aggregate of each year has been made up by items from somewhat different places. The cities of Bombay, Poona, and Karachi have been steady, but in the mofussil all the districts have not suffered severely in the same year, the *tálukas* within a given district have been affected some one year, some another, and the villages of a given *táluka* have been affected in a kind of rotation. I have shown on the screen the tables of nine villages, which on the whole agree in proving that each village has had one very severe outbreak, usually the first, that there have been years absolutely

clear, and that the subsequent outbreaks have been much less extensive than the original one. It is in the very notion or definition of the word "epidemic" that there shall be intermissions; the word "endemic" means a more steady prevalence from year to year; but in that notion also the steadiness is only in the aggregate of a whole country or province, not in the several counties or parishes of it. It is probable that all the villages of Bombay Presidency by this time have had their worst experience of plague, and that in each village plague has visited all the houses in turn, or as many of them as it is ever likely to visit. The Bombay figures for the season just ended are encouraging. Whether it be owing to the resolute practice of evacuation on the first signs of plague, or because the invasion is subsiding naturally, the returns since January have been only about one-third those of the three or four years preceding for the corresponding weeks. It looks as if the maximum had been reached and passed, both for each locality and in the aggregate of the whole Presidency, and that there is to be a pause. Such pauses occur in all epidemic infections. We account for them by a phrase or formula, that the infection has exhausted all the "susceptible subjects," and we explain the return of the epidemic after an interval of years by the fact that a new generation has grown up which contains more "susceptible subjects."

What can be proved from the admirably full statistics of the Bombay Presidency may be perceived in a way in the Punjab. Thus, in Jullundur in January this year I learned that the average was being kept up to that of former years chiefly by returns from a certain group of villages in the south-west which were having plague in them for the first time. The province as a whole is to have more plague-deaths this year than it has had hitherto; but it would certainly have shown a decrease but for the very large items of three districts in the Delhi Division—Gurgaon, Rohtak, and Hissar—which are having their first severe epidemic. The prognosis for the Punjab should be, that the infection has reached its height and done its worst for the time in the districts first attacked, and that it will soon begin to show a decline in the aggregate, following in the wake of Bombay Presidency.

This is the first year in which the United Provinces and Behar have returned such large totals as we have been accustomed to for several years in Bombay and the Punjab, and as one of them has a population nearly twice as great as these two latter together, it is unsafe to prophecy what heights plague may not reach in them before it begins to decline. In any case, we may reckon with plague domesticated in the soil of tens of thousands of villages, making an endemic area larger than that of cholera was ever estimated to be, and from such an endemic area we may expect future outbreaks at intervals of years, if not from year to year. In England, for 30 or 40 years after the great invasion of plague in 1348, a poet of the time compared the state of sickness to "the rain that raineth where we rest should," to the drip through a leaky roof, a chronic state of discomfort and uneasiness.

The three centuries of plague in European towns came to an end without any conscious effort to check the infection anywhere so far as one knows. The most probable explanation is that the towns had emerged slowly from their mediæval life, which was peculiarly favourable to plague, having thrown down their walls and gates, and gradually shifted the pressure of population to new sites, which, however, were often befouled by the accumulated refuse of the old walled city, and, therefore, apt to retain the infection many years longer. The curious statutes of 32 and 35 Henry VIII., on the decay of practically all the chief towns of England and Wales, bear out that hypothesis, according to the reading of their preamble adopted by Nicholls and Froude. At all events, mediæval limits were outgrown in all the towns of Europe, and, after a transition period of a century or more, plague died out by reason of changed conditions.

India, at the present day, contains more traces of changed sites than any country in the world, and some of these changes have actually occurred under British rule. Sometimes the changes of site have been caused by a river deserting its old channel, and leaving a city too far from the traffic; but there are undoubted instances of sites abandoned owing to chronic sickness. The British cantonments afford instances in the past, and may afford more in the future. Dacca and Berhampore were both condemned, the latter in 1833 after an original outlay of £300,000; they were healthy stations at first, and became sickly by degrees until they were untenable. What has been happening in India from time immemorial, both to town sites and to village sites, through the pressure of events, may be anticipated by a deliberate policy in order to hasten the disappearance of plague. In some of the towns of the Deccan and

Gujarat, new suburbs are actually springing up for the richer class, to avoid the infection. For the villages it is not out of the question that some law might be made to prevent rebuilding on the same foundation when the mud walls crumble, as they do periodically; but of such a law the essential condition would be the helping hand of the State to provide new sites. At one time I held that a progressive change of the village site to a clean soil, along with the break-up of a larger village into several hamlets, would be an effectual if very slow means of getting rid of plague. But after seeing a good many of those dreadful mud villages, I have come to think that it is their miserable structure that is the real reason why the Indian plains are cursed with plague, and that there can be no real cure without a more civilised kind of dwelling, and a great revival of the native building arts as village industries.

DISCUSSION.

The CHAIRMAN said he was sorry he was not in a position to speak from personal knowledge of the plague. Although he had had a great deal to do with the preparations in the Punjab to face the plague when it was then approaching, he left the province before it was actually attacked. The paper just read was most interesting, and the Society was greatly indebted to Dr. Creighton, and, indirectly, to the Leigh Browne Trust, under whose auspices he undertook the journey to India and made his researches. He (the Chairman) gathered that Dr. Creighton did not dispute the position taken up by bacteriologists as to the origin of plague, in other words he did not combat the idea that it was due to a bacillus. But Dr. Creighton did not hope for any great results from the inquiries of bacteriologists; he preferred to study the matter from an outside point of view. For himself, however, he ventured to express the opinion that a complicated and difficult problem of this sort had better be studied from all points of view, and that both Dr. Creighton's researches and the researches of bacteriologists were necessary. He had always been a great advocate for the encouragement and endowment of expert research, and in particular of expert medical research. In his early days he had been for a short time in a medical school, and he knew that no ordinary member of the Indian Medical Service (than whom there was no finer of its kind in the world), who was occupied with the immense labour of his professional work in India could possibly prosecute researches of this sort. No one could do so except a man who devoted his whole life to it. With regard to the Commission which had recently been sent to India under the joint auspices of the Secretary of State, the Lister Institute, and the Royal Society, it would, of course, be rash for anyone to predict success for it. He would say, however, that its objects were not limited in the way Dr. Creighton seemed to suppose. It was not going to confine its investigations to the field of bacteriology, and it would certainly not shut itself up in any laboratory. He might add that so far as its laboratory work was concerned, it was not going to Kassowlie but to Parel. He was sure that special attention would be given to Dr. Creighton's paper by that Commission. As he had already said, it would be unsafe to predict success for the Commission which had been sent out; and, similarly, it would be rash to assume that the conclusions to which Dr. Creighton was inclined to come would be established. Conclusions of that sort could only be based on deductions drawn from immense numbers of instances. Further observations would have to be made, and tabulated by various persons before any positive conclusion could be arrived at. Inasmuch, however, as Dr. Creighton had devoted the best part of his life to subjects of this sort, and as he was a most keen observer, it must be admitted that there was a considerable probability that the conclusions to which we was inclined to come, would turn out to be correct. It might happen that when the results of both his inquiries, and those of the bacteriologists came to be put together, differences of opinion would be found. No doubt it was awkward to have to decide when doctors disagreed; but, on the other hand, it was doubtful whether an immensely complicated problem like the present could be properly thrashed out, and a solution ever arrived at, unless doctors to some extent did disagree.

Lieut.-Colonel S. J. THOMSON, C.I.E., I.M.S., said he had had the pleasure of meeting Dr. Creighton during that gentleman's visit to India, and had done all that lay in his power to put him in the way of obtaining some of the information which the Society had been favoured with that evening. He (Lieut.-Col. Thomson) had had some experience of outbreaks of plague in India, and perhaps somewhat exceptional experience in the matter of *maha mari* in the hills in former times. The latter, which he thought, must be recognised as the same thing as plague in the plains, seemed to be largely, if not entirely, a soil disease. That certainly was the case in some villages where the attack was so severe that the disease could not be stopped until the village was not only quite evacuated, but disinfected, and the roofs burnt. It was often the case that after a year or two plague would recur in such villages, and to such an extent that some had to be eventually entirely abandoned. Up to that time he was inclined to believe that the disease was one entirely of locality, but later, when he came to see the disease on a more extensive scale in the plains, his views had been rather shaken. While conducting operations, he had had an exceptional opportunity of judging the

behaviour of plague during the outbreak at Hardwar. About a mile and a-half away was a second town called Kankhal, and about three miles further on was a large village called Jawalapur. These three towns, which constituted what was called the Hardwar Union, were so isolated naturally, that it was possible so to conduct operations as to cut them off from the rest of the province. A most interesting feature was that Hardwar was largely composed of houses built of masonry, brick, and stone, with cement floors, and in every respect corresponding to the description of houses which he understood Dr. Creighton would like to see all over India. Kankhal was a large pilgrim resort, and it, too, was strongly and permanently built with brick, stone, and cement. The third centre, Jawalapur, however, was quite different in character, being more in the nature of a large village. Indeed, the houses generally were very much of the kind which Dr. Creighton and many others would like to see abolished altogether. He was bound to say, as the result of very careful observation, that he did not see any particular difference in the behaviour of the disease in the *pukka* or cemented towns and its behaviour in Jawalapur. The disease was introduced in one case into a masonry building containing eleven people, but owing to the delicate condition of one of the women it was not deemed prudent to cause the house to be immediately evacuated, as would otherwise have been done. That house was particularly strongly and well built, and isolated, but it happened that before the authorities were able to get into it and deal with the matter, no fewer than nine out of the eleven died of plague. A point which had been rather missed, but which ought to be more particularly borne in mind, was the fact that the houses built of well-constructed masonry were generally occupied by fairly well-to-do persons who lived in somewhat similar conditions to Europeans living in India. Looking at the statistics, at first one was inclined to think that the great immunity of Europeans in India from plague was due to the fact that there was comparatively so few of them, but as time went on he thought it must be recognised that there was something more than that. As a result of his own observations, which were exceptionally large, and extended over a considerable period, he was inclined to put down the immunity of such places to the fact that there was not so much overcrowding in the well-constructed houses, that the people were cleaner, better fed and clothed, and altogether better to do. He might instance the pukka mahals in Benares as such a place. Although there were a few cases there, the area over which the disease spread was small. He was in entire agreement with Dr. Creighton as to the great advantage of voluntary evacuation, and he believed that in this direction lay the eventual solution of the difficulty. That lesson had been learned throughout India. Very little advice, and certainly no compulsion, were now necessary to induce the people to go out. In Oudh, in the Faizabad district, it was particularly easy to arrange that, because the country was thickly wooded. There, for generations the people had been accustomed to keep their cattle and fodder in the little groves outside the villages. Therefore, it was quite easy when an outbreak occurred, to persuade the people to move to those groves and live there, instead of in the villages, until the danger was past. It was no good, however, to use any form of compulsion, for then the disease would be concealed, and it could not possibly be dealt with. As soon as distrust entered the minds of the people, information as to the disease would be withheld by them, and when it was actually discovered by the authorities it would be found so extensive as to be entirely beyond control. Voluntary evacuation, under all the circumstances was, he thought, the best solution of the difficulty.

Professor W. J. SIMPSON said he congratulated Dr. Creighton on his interesting and instructive paper. If he understood Dr. Creighton right, his forecast as regards the behaviour of the epidemic of plague was hopeful so far as the provinces which had been so severely attacked were concerned, and it was devoutly to be hoped that Dr. Creighton's surmise would turn out to be correct. But the measure of comfort thus given was not very great for the decline which was observed in the places attacked appeared to be considered as only a pause or intermission until there was a renewal of susceptible subjects. He gathered from this that Dr. Creighton was no supporter of the doctrine that the plague would soon die out. Those who held this view had from the commencement of the epidemic very successfully, but most unfortunately for the interests of the Indian people, buoyed up the authorities with false hopes, with the result that there had been no continuous and organised effort on a sufficient scale to check the ravages of the disease and prevent its spread into non-infected localities. Plague had been now in India nine years. In the first year there were 30,000 deaths altogether; now they were, in a plague season, 30,000 and 40,000 deaths a week. In 1903 there were 853,000 deaths; in 1904, 1,040,000; and only last week the Secretary of State for India announced in the House of Commons that in January of this year there were 126,000 deaths, in February 126,000, and in March 199,000, so that in the course of the first three months there were nearly half a million deaths from plague. The total loss to India had been 3½ millions, and there was not the slightest sign of it dying out. Last year, when Mr. J. E. O'Conor read his able paper on "The Economics of India," and some of the speakers were inclined to take a very roseate view of the prosperity of India, he (Dr. Simpson) ventured to point out that no country could be said to be in a state of prosperity that was losing annually 1 in 300 of its population from a single disease. Since then he had had the opportunity of extracting from the official records the number of deaths from

plague in the different provinces, and he found, as was shown so well in the map prepared by Dr. Creighton, and contrary to the general impression, that plague was not spread over the whole of India, that many parts of the country still remained to be infected, and that the Punjab suffered the most severely, having lost no fewer than 350,000 of its population in 1904. The province of the Punjab had only a population of 27 millions, one, in fact, which was less than England, and it had lost last year not 1 in 300 of its population but 1 out of every 77 of its inhabitants. It was a province from which many of India's best soldiers were recruited, and it could not be with equanimity that the Government saw the country from which these fine soldiers were obtained being ravaged with plague. This anxiety must be emphasised if the reports which appeared in the newspapers were correct that 200,000 Russian soldiers were concentrated on the Afghan frontier. Dr. Creighton had shown in his paper that even this appalling mortality had been overtopped in some of the districts in which 1 out of every 33 of the population had succumbed to plague, and in some of the villages which had lost more than a fourth of their inhabitants in the course of several years. In dealing with the heavy mortality in some of the villages, Dr. Creighton had contrasted the condition of these villages with those that had escaped, but it was a question whether the villages that had hitherto escaped would retain their immunity. In the pandemics we read of one of the features of the disease was that it attacked one place and left another alone, but when left to itself it seldom forgot the omission and visited, sooner or later, the place which it passed over. With the disease concentrated chiefly in two provinces and with many more parts of the country to spread over, the outlook appeared to be of the gravest character. Few seemed to realise that never before, since the Black Death of 1348, had such an epidemic of plague prevailed in India or outside India. What happened then? According to the Russian records which give a different account of the origin of the Black Death from that given by Dr. Creighton in his splendid work, the "History of Epidemics in Britain," the origin of the Black Death is ascribed to India, from which it spread to southern Central Asia and thence to the Volga and the Don. In that epidemic Europe lost 25 millions of its inhabitants. The plague was, therefore, not only a great calamity for India, threatening to become a still greater calamity if left unchecked, but it might become a great danger to Europe. One of the most remarkable facts connected with this tragedy in India was the comparative lack of organised and sustained efforts adequate to the occasion to deal with the disease. He hoped that he should not be misunderstood; he knew the exceptional difficulties which the Government of India had to face, he knew also the danger of injudicious action, but weighing all these he thought there was abundant cause for dissatisfaction. When he found that half a million people died from plague in the first five months of 1904, and half a million died in less than 3½ months of this year,* and that there was no sign as yet of any extraordinary measures being undertaken to combat the disease and limit expansion, he felt that if this was not a time to speak out he did not know when that occasion could be considered to arise. The only unusual measure that had been taken was the appointment of a scientific Commission; but whether the climate of India was deemed to be too trying, or from some other cause, that Commission was not to study the disease on the spot, but to sit in London, and act as an Advisory Board. The real Commission, consisting of two assistant bacteriologists, were sent out to India to solve the many difficult problems connected with plague, and to over-top and surpass the work of five foreign Commissions, and one English Commission consisting of the highest scientific medical authorities in their respective countries. A Commission such as that now appointed will neither do any harm nor any good. What was wanted in this crisis was something worthy of the great nation that ruled over India and was responsible for its welfare, and this would not be obtained by sending out two assistant bacteriologists to India, where fifty were needed, nor would it be obtained by combating plague by an unorganised and totally inadequate administrative plague department. If Lord Kitchener were asked to meet a powerful invading army without a fairly sized trained service to fight the enemy, and without an intelligence department to keep him well informed no one would be surprised to hear that it was impossible, and yet this was the position in regard to plague. It was more powerful than any invading army. It multiplied in numbers and thus reinforced itself as it went along. It had ways of approach and attack that were not accurately known, It was also an unseen foe; and yet, with all these advantages over an ordinary enemy, it was expected to be met and controlled in a haphazard sort of way, without very much expense, without proper organisation and without strenuous effort, and because the whole thing was a disastrous failure the blame was laid on the people, their customs, and their prejudices. He earnestly hoped that a more enlightened policy would prevail.

Mr. Herbert M. Birdwood, LL.D., C.S.I., said that he had not the advantage possessed by the last two speakers of approaching the subject under discussion as a scientific expert. It would, therefore, savour of presumption on his part if he spoke any words in praise of the paper to which they had all listened with such keen attention. It would savour of something worse—of folly—if he attempted to criticise conclusions drawn by

* The Secretary of State for India has since stated in Parliament that the number of deaths from plague in India for the first four months of 1905 was 687,000.

so high an authority as Dr. Creighton from facts observed by him in his Indian tour—facts which the acquired knowledge and experience of a lifetime had qualified him to observe aright. Still he (Mr. Birdwood) had himself been concerned in administrative work in connection with the first epidemic of plague in Bombay in 1896-97; and facts and incidents had come to his knowledge, or fallen under his own observation, some of which he would like to adduce; and would leave it to Dr. Creighton to say how far any of them corroborated the views expressed by him, or called for explanation in reference to his conclusions. The part of Dr. Creighton's paper which interested him the most was that relating to two districts with which he was himself familiar, the sea-coast district of Ratnagiri, in the Konkan, to the south of Bombay, and the Satara district in the Dekhan, to the east of the Ghâts. The contrast between the comparative immunity from plague of the stone-built villages of Ratnagiri, in which the houses were often stretched out so as to form a long street of detached buildings, and were more or less open to the air, and the prevalent mortality in the compact mud-built villages in Satara, which were often enclosed with a village wall, was very striking. In Bombay, also, it was noticed that people who slept in verandahs of houses, or on cots in the open street, were less liable to attack in the infected quarters of the city than those who slept indoors, in crowded and ill-ventilated rooms. A cold night, which drove large numbers of people indoors, was generally followed by a sharp rise in the daily mortality. In the Himalayan districts, also, in an atmosphere and climate as fine as any in the world, the advantages of living in the open air in villages infected with the form of plague known as *maha mari* which had been described by Dr. Hutcheson, were entirely neutralised by the necessity felt by the inhabitants for crowding together for warmth and shelter in noisome huts. In the fishermen's village of Worli, a few miles out of Bombay, a determined attempt was made to keep the plague away by refusing admission to all strangers. Here, if anywhere, as Mr. Hankin reported, was a chance for a sanitary cordon to be successful. Nevertheless, the plague "broke out suddenly in the village with appalling virulence." Whether the plague germs were air-borne, or earth-borne, or carried by rats, or other ground animals, they were small enough to escape exclusion by the closest cordon, and they found congenial soil in the mud floors of the stuffy, unventilated dwellings of the villagers, most of whom, however, soon encamped in the fields, taking with them their bedding and household utensils. They came back every day to their houses to fetch grain, but, after camping out, they remained free from the disease. The Government of India held that the Worli incident supported the view that the plague is best combated by the evacuation of infected localities; and this seems to be Dr. Creighton's opinion also. In the Great Plague of London, an exactly opposite procedure was adopted. Houses were shut up when the plague appeared in them, and the inmates were not allowed to leave them; and the results were terribly fatal. Nearly 14 per cent. of the population of London died of plague in 1665. In Bombay, the highest estimate of plague mortality during the epidemic of 1896-97 did not exceed 2½ per cent. of the normal population of 820,000, which, however, was greatly reduced for several months by a large exodus of the people. In the second epidemic, the mortality slightly exceeded 3 per cent. of the population. As regards the comparative immunity of Ratnagiri villages from plague, notwithstanding the constant intercourse and traffic by sea between Bombay and the ports of the Konkan, Mr. Birdwood suggested that there might perhaps be some other controlling factors besides the nature of the dwellings in those villages. The average rainfall of the district was stated by Dr. Creighton to be about 100 inches in the year. But the actual rainfall on the verge of the Ghâts was much more. It amounted at Mahableshwar to 280 inches in the year. The effect of this downpour in the four monsoon months must be to scour the surface soil most thoroughly. Indeed, that had been the case in the past to a most lamentable extent. There was a time, in the early years of the past century, when the hills and valleys of the Konkan were well clothed with timber; when vessels of fair size could navigate some of the bigger rivers and creeks that traverse the district; but in an unwise moment the right to cut down their forests was conceded to certain landholders. The right was ruthlessly exercised, and when Dr. Creighton visited Mahableshwar he was struck, as others had been sadly struck before him, by the bare red, laterite, hilltops between him and the sea. As soon as the woods which protected the soil had been destroyed, the soil was washed away. The creeks also became choked with silt and *débris*, and no vessels of any size can now sail up those creeks. But, as the plague is a ground poison, might it not be reasonable to suppose that the heavy rainfall had done its work in washing away any traces of imported poison from the neighbourhood of human dwellings? On the east side of the Ghâts the case was otherwise. There we had the heavy black cotton soil, and the rainfall was greatly reduced. As the south-west monsoon winds come up from the sea, laden with millions of tons of vapour, which are condensed by the colder temperature of the higher ridges, they pass on with only a short supply of moisture left in them for the Dekhan, and, even at a distance of only ten miles to the east of Mahableshwar, the rainfall amounts only to about 30 or 35 inches; but, small as it is, it does not, owing to the configuration of the country and the nature of the soil, drain away as fast as the heavy rainfall of the Konkan; and waterlogged soil, if it is not itself a congenial home for the plague germ, at all events lowers the public health and lessens the power of resisting onslaughts of the disease. The effect of a heavy rainfall in checking plague mortality had

been noticed in China, where the people believe that the plague is favoured by a long continuance of dry weather, and that a downpour for two or three days will stop it. We have it, on the testimony of Mr. Fraser, the Consul at Pakhoi, that, as a rule, the summer rains, by washing the streets, put an end to the plague for the year. And the cessation of plague at Naples, in the seventeenth century, seems to have been ascribed to a similar cause; for we learn from the author of that most fascinating book, "John Inglesant," that the night after Inglesant had met the friar in Naples, there was "the sound of abundance of rain" and "the plague was stayed." And then again the higher temperature of the Konkan districts may have conduced to the comparative immunity from plague enjoyed by the people of Ratnagiri. The climate of the Konkan is warmer and damper than that of the high-lying Dekhan. It is warmer than that of Bombay; and though the steady rise during a long series of years of the level of the sub-soil water in Bombay, caused by the filling up of the flats and the blocking of several outlets to the sea undoubtedly had a most prejudicial effect on the public health and possibly prepared the way for the plague by predisposing people to disease, yet, according to Mr. Baldwin Latham, who, many years before the outbreak of the plague, had reported on the sanitary condition of Bombay, great dryness of the air is one of the climatic factors which favour the growth of an epidemic of plague. He found that the conditions, when measured by the dryness of the air, were identical in the several London epidemics and in the Bombay epidemic of 1896-97. Similar conditions may have favoured the prevalence of plague in the Satara villages. The subject is one of the gravest concern to the whole civilised world; and he (Mr. Birdwood) could only hope that, as Dr. Creighton had studied on the spot the questions connected with recent extensions of plague in India, he would, on some future occasion, supplement the conclusions he had arrived at as regards one of the causes of its continued prevalence in the Dekhan and the Punjab, with a paper on the results of his enquiries regarding the repeated epidemics in Bombay during the past nine years.

Dr. W. Scott Tebb (Public Analyst for Southwark) said he had not had any practical experience of plague, but as bacteriologist of one of the Metropolitan boroughs was much interested in the subject under discussion. They had learnt from Dr. Creighton's valuable paper the conditions under which plague thrives. There is, he (Dr. Tebb) thought, no doubt that this disease might arise by contagion from person to person; this was clearly indicated by the Vienna cases in 1898, when the laboratory attendant Barisch who had to do with plague material contracted the disease and communicated it to Dr. Müller his doctor and also to one of the nurses. The most important cause, however, which contributed to the propagation of plague was, as Dr. Creighton had shown, the presence of filthy conditions in and around houses, and it was these foul conditions, whether of soil or air, which were not only responsible for plague but also for typhoid, typhus, cholera, and small-pox. The theory that certain diseases were due to a micro-organism had tended to obscure and to throw into the background the fact of their insanitary origin. For his own part, as the result of experience, he had come very much to doubt the *rôle* played by certain so called "pathogenic organisms," that was to say, whether they were the actual cause of the disease in question. Take the comma bacillus of Koch. That was, at one time, confidently stated to be the cause of cholera, but Pettenkoffer, Klein, and others had shewn that this bacillus might be eaten with impunity and without producing any deleterious results whatever. Then there was the so-called "typhoid bacillus" of Eberth. In 1880 this was heralded as a great discovery, but it had since been shewn by Remlinger and Schneider that this bacillus is practically ubiquitous. Thus it occurs in the alimentary canal of those unaffected with typhoid fever, it occurs in potable waters, in the soil, and contributes to the microbial flora with which we are normally surrounded; in fact the bacillus is so widely diffused, that if it were the actual cause of typhoid fever the human race would long since have been exterminated. With regard to the "plague bacillus" of Kitasato it was shewn by Aoyama that the bacillus in the blood of patients differed from that found in the buboes. Crookshank says, "it is quite possible that the so-called plague bacillus is really identical with the bacillus of hæmorrhagic septicæmia and the real nature of the contagium in bubonic plague is unknown." But whatever be the truth about these important questions, and there certainly seemed much difference of opinion in the medical profession, he (the speaker) had no doubt that the microbial theory of disease colours all our ideas. Everything centred round the micro-organism. As Dr. Creighton had said, we "think bacterially," and the effect of this attitude of mind was shewn very clearly in the Report of the Indian Plague Commission of 1901. The Commissioners found that dirt in houses is not a good medium for the cultivation of the "plague bacillus" and hence "we can hardly find justification for the belief that plague is a filth disease in the sense that the growth of its bacillus is favoured by the presence of dirt." Again, in so far as dirt was associated with moisture, it might retard the destruction of the bacillus, otherwise "dirt in a house" appeared to be "a matter of indifference." Finally, we have the extraordinary conclusion that "a clean room may constitute as dangerous a nidus of infection as a dirty room, insomuch as the specific micro-organisms of the disease may effect a lodgment or remain in the room in spite of any amount of sweeping and cleaning." That was a truly hopeless doctrine, and one he was sorry to say for which bacteriology was mainly responsible. In his opinion, the only way to eliminate plague was

to attend to the sanitary surroundings of the individual. Plague and small-pox thrived in old London in the terribly filthy conditions which then prevailed, and they likewise flourish in India and China to-day; and it was only by making the people clean, in their habitations and in their towns, that these diseases could ever be effectually eradicated.

Lieut.-Col. ALLAN CUNNINGHAM said that, having lived in India for twenty-three years, he had listened with very great interest to Dr. Creighton's paper. It was one the saddest papers with reference to the inhabitants of India he had ever heard. The most important conclusions arrived at seemed to be that, unless the inhabitants would give up building with kutcha masonry—(mud)—and revert to building with solid materials, there was not much hope of getting rid of plague. Yet, to get them to do so was nearly an impossibility, and for two reasons. First, the three hundred millions of people in India were intensely conservative; and if they could give up building with earth, they would not do so. Secondly, if they wished to give it up, he was afraid the mass of them could, not simply owing to their intense poverty. They had recourse of necessity to the surrounding earth, simply because it was the cheapest material to be found.

Dr. E. H. HANKIN said that the paper to which they had listened with so much pleasure showed that in India, at all events, the white man's burden was the coloured man's microbe. The statistics which had been brought forward by Professor Simpson made one wonder what would be the eventual outcome of the present outbreak should it cross the Indian frontier while retaining its present virulence. Reference had been made to the relation of fleas to plague. The important discovery made by Captain Liston on the subject was that in the absence of plague the fleas proper to rats were not to be found on human beings; but in the case of persons residing in a plague-infected house where rats had already died the peculiar rat fleas were found on those persons. That obviously was a means by which the microbe could be transmitted. The important question for consideration, was, how long the present outbreak was likely to continue in India. In spite, of what had been said, arguing from the analogy of previous Indian outbreaks, if those outbreaks had only lasted ten or twelve years, he failed to see why the present outbreak should last longer than that. The fact that during the current year plague was more virulent than in previous years was not an important argument, because the disease had generally been most virulent just prior to its disappearance. To say that because Indian plague resembled the Black Death which lasted for 300 years, the present Indian plague was likely to last as long, did not appear to be a convincing argument, inasmuch as one event occurred in Europe, and the other in India. As far as the evidence went, whether an outbreak in India had been a limited or an extended one, it had never lasted for such an excessively long period. India in the past had been singularly free from prolonged pestilence, and he failed to see why the same state of affairs should not persist.

Dr. CREIGHTON, in reply, said he could hardly, at that late hour, deal in detail with the many points raised by the various speakers. He believed he could make some reply to Colonel Thomson's instance of Hurdwar. With regard to Professor Simpson's remarks, he did not take so pessimistic a view as that gentleman on the extension of the area of plague in India, and he did not expect an extension into Europe. As to Colonel Cunningham's practical answer, he was well aware how valid it was. At the same time one must recognise the facts, and if there were to be any deliberate policy adopted to shorten the duration of plague and to anticipate the pressure of events, the kind of habitations of the peasantry must be looked to more than anything else. One knew how impracticable such suggestions often were, and no one felt that more than himself, coming fresh from seeing the kind of villages in the plague-infected districts. Numerous criticisms had been made by Mr. Birdwood and other speakers who had taken part in the discussion to which he would gladly have replied had time permitted, and he promised to entertain them at greater leisure.

At the conclusion of the meeting, a hearty vote of thanks was accorded to Dr. Creighton for his able and important paper.

IRISH EMIGRATION STATISTICS.

The emigration statistics of Ireland for 1904 show that although there was some falling off as compared with 1902-3—a decrease of 3,244—the actual emigration, notwithstanding the diminished population, was considerably larger than in 1897 and 1898. The emigrants who left the Irish ports during the year 1904 numbered 37,415, or 8·5 per 1,000 of the estimated population of Ireland in the middle of the year. The number of males who emigrated was 17,524, or 1,779 less than in the previous year, and the number of females 19,891, a decrease of 1,465. Of the total emigrants in 1904 there were 36,902 natives of Ireland, and 513 were persons belonging to other countries. In comparison with 1903 the number of emigrants, natives of Ireland, shows a decrease of 2,887, and the number of persons belonging to other countries a decrease of 357. The emigration returns were first collected in 1851 and from May of that year to the end of 1904, the total number of emigrants, natives of Ireland, who left Irish ports was 3,997,913—2,076,072 males and 1,921,841 females. The highest

number of emigrants in any one year was 190,322 in 1852, and the lowest 32,241 in 1898. In the decade from 1866 to 1875 the average number of emigrants was 74,667, in the decade 1856 to 1865 the average annual number amounted to 88,272, and in the four preceding years, from 1852 to 1855, the number averaged 148,985 annually. After 1887 there was a gradual annual decline to 35,895 in 1894; in 1895 the number rose to 48,703; it then fell to 38,995 in 1896, to 32,535 in 1897, and to 32,241 in 1898. It rose to 41,232 in 1899, and to 45,288 in 1900, and fell to 39,613 in 1901, rising to 40,190 in 1902. The number of emigrants fell to 39,989 in 1903, and to 36,902 in 1904.

It is not only that the emigration from Ireland has been continuous and large. It has taken away from the country the cream of its manhood and its womanhood. Of the 37,415 emigrants in 1904, 62·9 per cent. were between the ages of 15 and 25, and 20·9 per cent. between the ages of 25 and 35. The quinquennial age-period, 20-25 years, furnished the largest number of both male and female emigrants—the persons of this age forming 40·2 per cent. of the entire number of emigrants. The only quinquennial age-period in which the females greatly outnumbered the males is that between 15 and 20, when the number of females was 6,175 and of males 2,309. Of the males who emigrated, 17,524 in number, 1,527, or 8·7 per cent., were described as married men or widowers. Of the 19,891 females, 2,265, or 11·4 per cent.. were returned as married or widowed. Of the 15,036 persons between the ages of 20 and 25 years, 290 only were married—66 males and 224 females.

An immense majority of the emigrants, 30,580, or 82·9 per cent., went to to the United States, and 9·4 per cent. to Greater Britain. The emigration to British colonies was insignificant. Canada took most of it, the number being 2,083. Only 336 Irish emigrants went to Australia in 1904, 123 to New Zealand, 298 to South Africa, and 6 to India. It is worthy of note that of the 28,755 Irish emigrants who travelled as steerage passengers to the United States there were 10,739 whose passages were paid for in America.

INDUSTRIAL ALCOHOL IN AMERICA.

The following particulars respecting the action taken in the United States in respect to industrial alcohol are from the *Pharmaceutical Journal*:—

In the matter of alcohol used for manufacturing purposes Great Britain and America suffer at the present moment from the same disabilities. At one time it appeared as though America would be the first to remedy this defect in legislation. In the United States the greatest opposition has not come from the Inland Revenue authorities, but, curiously enough, from enthusiastic teetotalers.

The United States, however, are not likely to be behindhand in this respect much longer. The committee of manufacturers which has the matter in hand has just drafted a new Bill, having decided to abandon all other measures dealing with the same subject which have been presented in Congress. The great majority of legislators are now in sympathy with the claims of manufacturers, so that in all probability the measure just drafted will not meet with the fate of its predecessors. The chief features of the Bill are briefly as follow:—Distilled spirits of high alcoholic strength, when rendered unfit for use as a beverage, to be removed from distillery warehouses, free of tax, under certain regulations to be prescribed by the Commissioner of Internal Revenue. The tax on high-proof alcohol and high-proof Cologne spirits to be reduced to 70 cents. per proof gallon; the tax on all other forms of distilled spirits to be reduced to 80 cents. per proof gallon.

In order that the Revenue may not suffer as a result of these proposed concessions it is provided in the Bill that an additional tax be placed on rectified or compounded distilled spirits used solely as a beverage. By this means it is estimated that the yield from the duty on spirit, under present conditions, will amount to 157 million dollars, as compared with a revenue in 1904 of 129 million dollars. It will be judged from this that the Internal Revenue authorities are not likely to put much opposition in the way of the Bill. Stringent regulations are to be enforced with a view to diminishing the risk of industrial alcohol being used for illicit purposes. Spirit removed free of tax from distillery warehouses must not be stored on any premises in which the business of a distiller, rectifier, wholesale or retail liquor dealer is carried on. The penalty for rectifying such spirit so as to remove any substance which has been added for the purpose of rendering it undrinkable is to be not less than 500 dollars and not more than 5,000 dollars, and imprisonment for not less than six months and not more than three years.

OBITUARY.

George Handasyde Dick. — Mr. G. H. Dick died on the 17th ult. at his residence at Strone, N.B., after a long illness. He was born at Bridgeton about 1838 and went to India early in life for a commercial training. On returning to England he set up for himself as an East India merchant at Glasgow. Other firms were formed later in connection with his business in Manchester, Bombay, and Rangoon, of which firms he was chief partner. He was President of the Chamber of Commerce, and at one time Rear-Commodore of the Clyde Yachting Club. He was elected a member of the Society of Arts in 1900.

GENERAL NOTES.

THE CURRANT TRADE AND A CURRANT BANK.—The coming currant crop of the Morea promises to be so large that the Greek Government will no longer encash the duty in kind. It is expected that the amount of currants available for export will be increased by 15 per cent., and as consumption seems to be on the decline in most markets the future for the currant growing is not bright. The Currant Bank was founded when the Retention Law was passed, and derives its capital from the proceeds of the currants which are deposited in its stores by exporters without the bank giving any equivalent for them. During the first year of its existence, writes Mr. Consul Wood in his Report dated April 12th last (3369, Annual Series), the bank encashed several millions of drachmæ from the annual sales of these retention currants, and these moneys were, according to the spirit of the bank's charter, distributed in loans, bearing small interest, to currant growers, either in the shape of cash, sulphur, or sulphate of copper, which the bank imported, as being necessary for the protection of the vineyards against the oïdium, peronospors, and other maladies. So long as currant growers were fairly prosperous a portion of the loans was annually repaid but of late years their condition has become so precarious that they have been quite unable to carry out their obligations, and the bank has been almost completely drained of its moneys. Being thus without capital, it cannot afford to import sulphate of copper, which is the only remedy against the peronospors malady, and as growers generally cannot afford to do so, a reduction in the area under cultivation would seem inevitable. There has ceased to be any demand in France, Italy, and Germany for wine made from currants. On the other hand, the growth of sultanas, the favourite raisin, is largely on the increase.

TEA AND DUTIES.—A reduction in the tea duty was not unexpected. At the end of March there were 127,000,000 lbs. in bond compared with 101,000,000 lbs. on the corresponding date of last year. To what extent the consumer will benefit from the remission of duty is doubtful. The poorer kinds of tea were never cheaper in Mincing-lane, or as cheap as during the past year, when the duty was 8d. Duty is only one of the determining factors of price, and with an 8d. duty the newspapers have been advertising a well known tea dealers' "really good tea" at 1s. 2d. per lb. The variations of the duty have been many. From 1801 to 1805 tea selling at or above 2s. 6d. per lb. was subject to a duty ranging from £30 to £95 2s. 6d. per cent.; if sold under that price from £20 to £65 2s. 6d. From 1806 to 1818 a uniform duty of £96 per cent. was imposed, which continued with an additional duty of £4 per cent. on tea selling at above 2s. per lb. down to 1833, the last year of the *ad valorem* duty. In 1834 and 1835 the duty ranged from 1s. 6d. to 3s. per lb. according to the class of tea; from 1836 to 1839 all kinds of tea were rated at 2s. 1d. per lb. with 5 per cent. in addition from 1849 to 1852. In 1853 the duty was 1s. 10d., and from that year the duty was gradually reduced, till in 1865 it was fixed at 6d. On 1st May, 1890, the duty was reduced to 4d., and was raised again to 6d. on the 6th March, 1900, and to 8d. last year. From July 1 next there will be a return to the sixpenny duty. Almost all our tea now comes from British India and Ceylon, Natal supplying a little, but the imports from China show signs of renewed expansion, and Java and other foreign centres are likely to be serious competitors before many years have passed.

TRADE OPENINGS IN MANCHURIA.—It may be gathered from Mr. Consul Little's report on the trade of Newchang (No. 3354, Annual Series), that after the war Manchuria is likely to be a good market for labour-saving implements. Contrary to what is the case in most parts of China, farming is carried on in Manchuria on a comparatively large scale, the average size of the holdings being 100 to 200 acres, extending occasionally to 1,000 acres. There is therefore ample scope for the use of labour-saving implements, for which a demand may be expected to arise after the war. Mr. Little says that just before the war a wealthy native, who had acquired a large property in the Imperial Hunting Park, which has now been thrown open to settlers, placed an order with a foreign firm for a complete set of steam ploughing and threshing tackle, costing in all over £1,000. The demand is likely to be stimulated by the scarcity of draught animals from which farmers will be sure to suffer owing to the large numbers used up in the war.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 19...British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, JUNE 20...Asiatic, 22, Albemarle-street, W., 3 p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Rev. Prof. Henslow, "Plants of the Bible."

WEDNESDAY, JUNE 21...Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Mr. George C. Simpson, "Normal Electrical Phenomena of the Atmosphere." 2. Mr. S. P. Fergusson, "Two new Meterological Instruments: 1. Automatic Pole Star Light Recorder, and 2. The Ombroscope."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. A. E. Conrady, "Theories of Microscopical Vision." 2. Mr. Edward M. Nelson, "The Tubercle Bacillus."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JUNE 22...Antiquaries, Burlington-house, W., 8½ p.m.

FRIDAY, JUNE 23...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Mr. J. Starkie Gardner, "The Monumental Uses of Bronze."

SATURDAY, JUNE 24...Botanic, Inner Circle, Regent's-park, N.W., 3½ p.m.

Journal of the Society of Arts.

No. 2,744. VOL. LIII.

FRIDAY, JUNE 23, 1905.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal* in accordance with Sec. 40 of the Society's By-laws:—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1905.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1904				2,326	13	7
,, Subscriptions	5,797	1	0			
,, Life compositions	525	0	0			
				6,322	1	0
,, Dividends and Interest				621	9	8
,, Ground Rents				670	15	11
,, Examination Fees				3,238	16	6
,, Clothworkers' Company (Donation to Examination Prize Fund)				30	0	0
,, Conversazione, 1904 (sale of tickets)				103	0	0
,, Advertisements				690	18	9
,, Sales, &c.:—						
"Cantor" Lectures	18	9	6			
Examination Programmes	46	16	10			
Fees for use of meeting-rooms	51	8	3			
Journal	157	10	3			
				274	4	10
,, Bequest by the late Mrs. Begley				250	0	0
				£14,523	0	3

Cr.

	£	s.	d.	£	s.	d.
By House:—						
Rent, Rates, and Taxes	846	18	4			
Insurance, Gas, Coal, House expenses and charges incidental to meetings	361	7	5			
Repairs and Alterations	79	19	4			
				1,288	5	1
,, Office:—						
Salaries and wages	2,245	4	5			
Stationery, Office Printing and Lithography	465	15	8			
Advertising	112	9	6			
Postage Stamps, Messengers' Fares, and Parcels	374	16	3			
				3,198	5	10
,, Library, Bookbinding, &c.				93	2	0
,, Conversazione (1904)				475	15	9
,, *Journal*, including Printing and Publishing				2,152	10	1
,, do. 10-Volume Index				182	12	0
,, Advertisements (Agents and Printing)				290	12	5
,, Examinations				3,028	13	0
,, Medals:—						
Albert	21	6	6			
Society's	21	17	5			
				43	3	11
,, "Swiney" Prize				20	0	0
,, "Owen Jones" Prizes				46	4	6
,, Drawing Society's Prizes				11	13	6
,, "Shaw" Prize				1	1	6
,, North London Exhibition Prizes				14	14	0
,, "Cantor" Lectures				265	7	9
,, Sections:—						
Applied Art	60	0	0			
Colonial	57	18	4			
Indian	68	12	3			
				186	10	7
,, Committees (General Expenses)				19	12	0
,, Committee on Leather for Bookbinding				19	17	6
,, London Institution Committee				17	9	6
,, Investments:—						
Life Compositions for the year £525, and bequest by Mrs. Begley £250, in War Loan				775	0	0
				12,130	10	11
,, Cash in hands of Messrs. Coutts and Co., May 31st, 1905				2,397	9	4
				£14,528	0	3

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	753 15 2	
„ Examiners' Fees	1,0 3 16 0	
„ Examination Prizes and Medals	193 0 0	
„ Sections :—Applied Art, Colonial, and Indian	170 0 0	
„ Accumulations under Trusts	328 15 10	
		2,500 9 0
„ Excess of assets over liabilities		25,068 17 9
		£27,578 6 9

Assets.

	Amount of Stock, &c. £ s. d.	Worth on 31st May, 1905. £ s. d.	£ s. d.
By Society's Accumulated Funds invested as follows:			
Consols	1,976 5 7	1,799 13 0	
Canada 4 per Cent. Stock	500 0 0	505 0 0	
South Australia 4 per Cent. Stock	500 0 0	515 0 0	
N.S. Wales 3½ per Cent. Stock	530 10 1	527 16 10	
N.S. Wales 4 per Cent. Stock	500 0 0	545 0 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	266 18 2	
Queensland 4 per Cent. Bonds	1,500 0 0	1,530 0 0	
Natal 4 per Cent. Stock	500 0 0	550 0 0	
Ground Rents (amount invested)	10,496 2 9	10,496 2 9	
Metropolitan Water Board B. Stock	321 15 9	410 5 7	
National War Loan	4,351 17 11	4,319 5 1	
	21,393 12 1		21,465 1 5
„ Subscriptions of the year uncollected		772 16 0	
„ Arrears, estimated as recoverable		279 0 0	
			1,051 16 0
„ Property of the Society (Books, Pictures, &c.)			2,000 0 0
„ Advertisements due			264 0 0
„ Cash in hands of Messrs. Coutts and Co., 31st May, 1905			2,397 9 4
„ Do. on Deposit (against interest on Trusts)			400 0 0
			£27,578 6 9

Funds held in Trust by the Society.

Dr. Swiney's Bequest	£4,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100 0 0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133 6 8	„ „ „ of Interest as a Money Prize.
North London Exhibition Trust	192 2 1	„ „ „ "
"Fothergill" Trust	388 1 4	„ „ „ of a Medal.
J. Murray, in aid of a Building Fund	54 18 0	„
Subscriptions to an Endowment Fund	562 2 2	„
Dr. Aldred's Bequest	220 2 3	„ chargeable with the Award of a Prize.
Thomas Howard's Bequest	571 0 0	Metropolitan Railway 3½ per Cent. Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	2,450 0 0	Bombay and Baroda Railway Stock } Interest applied to the Cantor Lectures.
	2,695 11 3	Ground-rents }
"Owen Jones" Memorial Trust	423 0 0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On Deposit with Messrs. Coutts and Co.
	£14,726 9 9	

Total of Investments &c., Standing in the Name of the Society (including Society's accumulated Funds and Trusts as above).

Ground Rents (amount of cash invested)	£17,669 4 0	
Consols	3,626 18 1	
Metropolitan Railway 3½ per Cent. Preference Stock	571 0 0	
Bombay and Baroda Railway 5 per Cent. Guaranteed Stock	2,450 0 0	
Canada 4 per Cent. Stock	923 0 0	
South Australia 4 per Cent. Stock	605 16 0	
New South Wales 3½ per Cent. Stock	530 10 1	
New South Wales 4 per Cent. Stock	500 0 0	
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170 0 0	
Queensland 4 per Cent. Bonds	1,500 0 0	
Natal, 4 per Cent. Stock	500 0 0	
Metropolitan Water Board B. Stock	321 15 9	
National War Loan	4,351 17 11	
Cash on Deposit with Messrs. Coutts and Co.	400 0 0	
Society's Accumulated Funds	21,393 12 1	£36,120 1 10
Trust Funds held by Society	14,726 9 9	

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

Owen Roberts, }
Carmichael Thomas, } *Treasurers.*

Henry Trueman Wood, *Secretary.*
Society's House, Adelphi, 20th June, 1905.

Knox, Cropper and Co., *Auditors.*

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-first Annual Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 28th June, at 4 p.m.

(By Order of the Council),
HENRY TRUEMAN WOOD,
Secretary.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

The following is a list of the *Vivâ Voce* Examinations which have been held since the last announcement in the *Journal* for February 3, 1905:—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French:—					
Crouch-end Council School	March 29, 1905	40	5	28	7
Willesden Polytechnic..	March 30, 1905	22	3	11	8
Acton and Chiswick Polytechnic	March 31, 1905	31	2	21	8
Manchester Education Committee	May 16, 1905.	21	4	11	6
Birkbeck College (Candidates from London Polytechnics)	May 30 & 31, 1905.	69	6	51	12
Battersea Polytechnic (Candidates from London Polytechnics)	June 1, 1905.	33	4	18	11
L.C.C. Evening School, Sussex-road, Brixton..	June 14, 1905.	30	2	23	5
L.C.C. Evening School, Queen's-road, Dalston	June 15, 1905.	23	2	16	5
L.C.C. Evening School, Choumert-road, Peckham	June 16, 1905.	26	1	20	5
L.C.C. Evening School, Tottenham rd., Kingsland	June 17, 1905.	23	6	13	4
German:—					
Manchester Education Committee	May 19, 1905.	9	4	5	—
City of London College (Candidates from London Polytechnics)	May 31, 1905.	36	6	19	11
Spanish:—					
Manchester Education Committee	May 17, 1905.	18	3	8	7
Portuguese:—					
Manchester Education Committee	May 15, 1905.	5	—	4	1
		386	48	248	90

The Examiners were Mr. E. L. Naftel for French, Professor H. G. Atkins, M.A., for German, Professor Ramirez for Spanish, and Mr. J. d'Oliveira e Silva for Portuguese.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner-circle, Regent's-park, on Tuesday evening, the 4th of July, from 9 to 12 p.m.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club-house will be open.

The Reception, by Sir William Abney, K.C.B., F.R.S., Chairman, and the other Members of the Council, will be held at the entrance to the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

A collection of Liliums in Pots will also be arranged in the Corridor.

A Selection of Music will be peformed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Grenadier Guards in the Gardens, commencing at 9 o'clock.

Two performances of Selections from Pastoral Plays will be given in the Gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.45 p.m.

A concert and entertainment, including a scene from "The School for Scandal," will be given in the Club-house, from 10 to 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards have now been issued. A limited number of tickets will also be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

THE WATER OF THE SOIL.

The following is an abstract of a report by Dr. J. Walter Leather, the Agricultural Chemist to the Government of India, communicated by Mr. Sidney Preston, C.I.E., Inspector-General of Irrigation, Calcutta:—

A correct knowledge of the quantity of water in the soil under varying conditions, the portions of the rainfall that respectively pass permanently into the soil or evaporate, the nature and velocity of its movement, and the quantity of water required by crops, is of agricultural importance in all countries, but specially in the tropics if the rainfall is unevenly distributed, and long dry periods occur annually. Yet little is known in the quantitative sense of the soil water of India. Probably the reason is twofold. The period of dry weather may be bridged over, and crops brought to perfection by running moderate quantities of water on the land, and the writers of text-books on soils, especially the earlier ones, have spoken of the rain-water descending into the soil without commenting on the nature of the phenomenon, and they then liken the rise of water during dry weather to that which takes place if a lump of sugar is dipped into a cup of tea, or a lamp wick into the oil well. Probably nothing has militated more against an exact study of the subject of soil moisture than these illustrations. They seemed to fit the case exactly, for if a lump of dry earth is similarly placed in water the latter rises rapidly like the tea into the sugar. But if the conditions under which water exists in the soil may be thus explained it is obvious that no drought, however prolonged, would affect the growing crops provided there is underground water, and conversely, since the tea rises an inch into the sugar in a few seconds and would pass downwards even more rapidly, the heaviest of rainfalls must be readily absorbed by the soil. But plants suffer from drought when very large quantities of water are only a few feet from them, and if a heavy shower occurs, the soil is frequently unable to absorb it all, some flowing away into the nearest drainage channel. It is only when one considers the subject in this broad, quantitative sense that the imperfection of such text-book illustrations becomes apparent.

If soil is examined under the microscope it will be ound that the greater part of it is derived from rocks. The size of most of the pieces is quite small, many of them measuring not more than ·001 mm. in diameter. We may further take the soil, separate the coarser fragments with sieves, and then further separate that which passes through the sieves into different grades of fine material by means of running water. If we can effect a separation of those particles which measure, for example, on the average ·002–·008 mm. from those which measure ·008–·016 mm. we shall obtain an interesting insight into the relative quantities of such material. The figures show that of every 100 lbs. of each of the soils a very high proportion consists of very fine material, and that even in a stony soil like that in the Dun the amount of fine material is greater than one might have expected.

Unfortunately, we have no means of determining the amount of true colloid clay in a soil. Most of it will separate with the finest silicious matter, but some of it adheres sometimes to the coarse material. This is especially the case with the Regur. On the other hand, it is not possible to prevent a good deal of fine silicious matter from separating with the greater part of the clay. Consequently, the finest material which can be separated consists of clay and sand. In the case of Black-cotton soil, this is probably largely true clay, but the microscopical examination of the corresponding part of the Cawnpore soil shows it to consist principally of non-colloid silicious matter. From these mechanical analyses of soils information regarding the number of particles per unit volume and the total surface possessed by them is obtainable. If we assume them to be spherical, and that the specific gravity lies between 2·5 and 2·7, we may calculate both the above quantities. It is true that they are not spherical, but of somewhat irregular shape, but since a knowledge of both the quantities in question is of importance to our subject approximate information is valuable. We may notice the following facts which these calculations demonstrate:—

(*a*) By far the greater number of soil particles are very minute.

(*b*) By far the greater number of them are much about the same size, and

(*c*) The total surface area of each cubic foot is very great.

The next point to notice is that under no circumstances can any space be entirely filled by this soil material. Since the particles are not bodies of regular shape, with plain surfaces, there must be a certain amount of the space unoccupied by this mineral material, and we call this the *interspace*. How great is this interspace? An answer may be obtained by two means. The first is a geometrical one. If we assume a series of spheres of diameter 1 to be packed together, they may occupy the spaces in either the arrangement A or B of the diagram. (Figs. 1, 2.) The former is the looser arrangement, and admits of interspaces equal to 47 per cent. of the whole space; the latter, B, is the closer formation, and the volume of the interspace equals 26 per cent. of the whole. If, now, smaller spheres be packed up into the interspaces of either of these formations so as to touch the larger spheres, an *equal number* of such smaller spheres will be required, and the volume of interspace will become materially diminished. If this process can be indefinitely repeated, the volume of interspace will become indefinitely small. If, then, the soil consists of approximately equal numbers of particles of certain sizes, it would be possible for the volume of interspace to fall to a small percentage of the whole. But by far the greater number of the particles in soils are much about the same size mixed with comparatively few larger ones, and consequently under no conditions can the volume of interspace fal

to a very low figure. It must, indeed, be usually a large proportion of the whole. It will be least in the case of a soil containing the most uniform number of particles of the several sizes, and this is probably the case in *sandy* soils. This is more or less substantiated by the fact that sandy soils weigh considerably more, usually one-quarter more than loams and clays, whilst the specific gravity of the material shows a difference of only about 1 to 25.

FIG. 1.

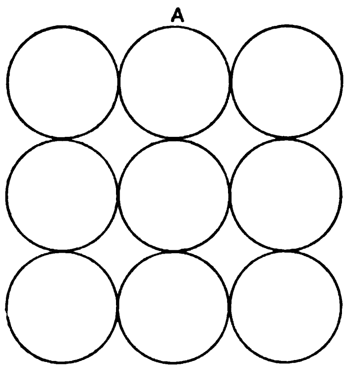
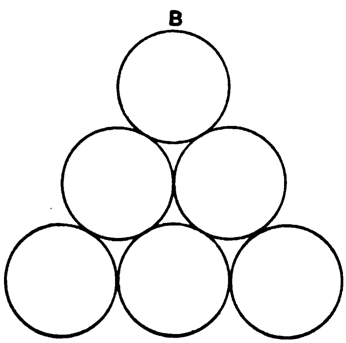
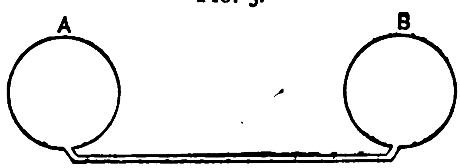


FIG. 2.



There is another way of determining experimentally the value of such interspace. If a block of soil of specified dimensions be taken, dried thoroughly, and then weighed, and if the mean specific gravity of the material be determined, the weight of a volume of water equal to dry soil may be readily calculated, and this, compared with the weight of a volume of water equal to the dimensions of the soil *in situ*, will provide the relative volume of interspace. Before passing to a consideration of the movements of water in soil it is desirable to point to two important facts. The first is that the soil of our cultivated fields two to three feet below the surface is never dry, and usually contains considerable quantities of water. The explanation of this will appear presently. The second is that the surfaces of the soil particles are "clean" in the same sense that a plate of glass is that has been treated with caustic soda solution. If water be brought on to such a piece of glass it will flow uniformly over it, like mercury does over a surface of amalgamated zinc, and the water will not tend to collect itself up into drops. This state is due to the fact that the soil is generally in a basic condition. Consequently water has no difficulty in flowing over such surfaces, even in very thin films. Suppose rain falls? The first water will flow in between the uppermost layer of particles. But having thus occupied these spaces, its further progress is impeded, for it has enclosed the gases which are present in the interspaces of the stratum immediately below. These gases cannot escape upwards because they would require greater force then they possess to break the enclosing films of water. Nor can they escape downwards because they are bounded by the underground water. More rain-falling pressure is brought to bear on the first quantity, and it can only pass down by one means—it must pass between the gases and the mineral matter. They are thus surfaces of water separated from one another by small quantities of gas. The form which such water surfaces will assume at the narrowest poiuts will compel it to run together, thus forming an intercepting film. Thus, with a lengthened rainfall the interspaces of the soil will become uniformly occupied by water and gases. If the rate of supply of water is greater than can pass through such minute spaces in unit of time, then it remains on the surface or runs off into the nearest channel. It is also to be noticed that the enclosed gases will be under an increased pressure at this time. If the water supply is limited to the rainfall, this will be nominal. If water is standing on the surfaces, this pressure becomes considerable. Moreover, equilibrium will not be established instantaneously through thick strata of soil. If pressure is applied to any vessel containing a liquid and a gas, it is transmitted to all parts of the vessel at once. But if two vessels, such as A and B (Fig. 3), containing liquid and gas are connected at the lower surfaces by a comparatively very narrow tube, and pressure is applied to A, equilibrium will not be established in B until a certain quantity of the liquid has flowed from A to B, and this would occupy time.

FIG. 3.

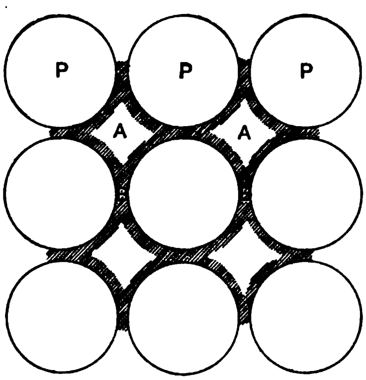


This is the case in the soil, and the pressure which an addition of water produces near the surface almost instantaneously, requires an appreciable time to be produced in the lower strata. This is doubtless one reason why drainage recommences even in constantly wet weather only after the lapse of some hours from the time when the rainfall recommences, and for the same reason it does not cease suddenly in the subsoil with cessation of rain.

If the atmosphere happens to remain saturated with moisture no water will evaporate. But usually the humidity decreases rapidly after rain ceases, and although the degree of humidity at this time varies greatly, it will be sufficient for our purpose to consider an atmosphere with 75 per cent. relative humidity at a temperature of 80° Fahr. Such an atmosphere is capable of taking up 2·83 grains of water per cubic foot. Furthermore, it is never still, but moves in various directions over the surface of the land, not only horizontally, but at other various angles to the horizontal. We need only consider a low velocity, namely, ½-mile per hour. Such a velocity would bring 2,640 feet of air over each square foot of surface per hour, or 63·360 feet per day. If a stratum of such air only one foot thick is considered then the air which comes in contact with each square foot of surface per day is capable of taking up 179,300 grains, or 395·3 lbs. of water. These conditions show that the atmosphere is capable, even under the very limited conditions stated, of readily absorbing any moisture which is actually exposed to it at the surface.

Turn to the water in the surface soil and consider its position. (Fig. 4.)

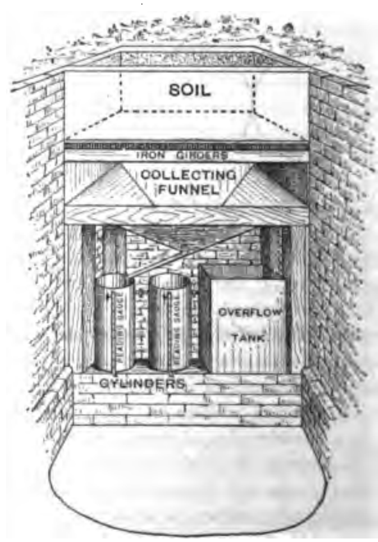
FIG. 4.



P P P represents soil particles, A A water films between the uppermost particles, B B similar films between those particles next below. At the points, A A, in the diagram, its surface is exposed to the atmosphere, and evaporation will take place. One of two things must now happen. If water can pass from the points B B to A A sufficiently rapidly, then evaporation will continue there. If, on the other hand, the water is unable to pass rapidly enough from B to A, then these will disappear, the surface particles will become dry, and evaporation can take place only at the points B B. In the former case it will be clear that water passing from B B to A A will reduce the thickness of films B B, unless water flows from similar supplies underneath so fast as to supply the loss. If the second of the supposed conditions ensues, and the evaporation has to take place not at the points A A but at points such as B B, below the surface the rate of evaporation must be infinitely slower, for the water at B B cannot pass from the liquid to the gaseous state until the previously evaporated water diffuses through the narrow passages, A A.

We will now turn to a consideration of the proportion of the rainfall that annually evaporates again into the atmosphere and that which percolates, after which it will be seen that we have some data on the subject of the rate at which water descends. There is one very simple and accurate method of determining what portion of the rainfall percolates through soils. If a rectangular mass of soil, whose upper surface is exposed to the weather, is isolated, and whatever water percolates from it is measured, this quantity is readily calculated into inches per acre. The difference between this quantity and the rainfall will either be in the soil, or it has evaporated, or some of it, in the event of heavy rainfall, may have run off the surface without being absorbed at all. The latter contingency will be excluded from our consideration, because, though it occurs so generally in India, it plays no part in the data that will be produced. Such masses of earth have been called "Drain gauges," by Lawes and Gilbert; in America, they are called "lysimeters." There are two modes by which such masses of earth may be isolated. The one is to pack earth into a suitable receptacle provided with a false bottom, and supplied with vessels to collect and measure the water which percolates; the second method is the one adopted by Lawes and Gilbert. The attached diagram will explain the general arrangement of these gauges. (Fig. 5.)

FIG. 5.



They consist of blocks of earth which have never been disturbed. The earth which originally surrounded these blocks was removed, and the containing walls built. Iron bars were placed horizontally underneath, and then the collecting vessels attached.

Such earth is obviously a much safer guide to the information in question than when recently disturbed earth is used. But these gauges require great care in construction, and even then a crack may form. However, this source of error is readily detected, because much larger quantities of water would percolate than should be the case, and the water would contain little or no nitrate, whereas true percolation water contains very material quantities of these salts. Three such percolation gauges were constructed at Rothamsted in 1870, and they consist of blocks measuring 7 feet 3·12 inches $\times$ 6 feet $=$ 1-1000th acre in surface area. They are respectively 20", 40", and 60" thick. They are kept entirely free from vegetation.

Information regarding the moisture condition of Indian soils is urgently needed, and it is hoped to see several gauges constructed here from which to obtain records similar to those of Rothamsted. A beginning has been made at Cawnpore, where Mr. Hayman, the Deputy Director of Agriculture of the United Provinces has constructed four gauges, two of three feet and two of six feet thick. As they were only made in 1903 it is too early to publish figures, but one thing may be mentioned. At the conclusion of the 1903 monsoon the gauges ceased running, and no measurable quantities of percolation water were obtained after the middle of November. A block of soil three feet thick cannot produce percolation water until a certain amount of water is in it. From such soil as that at Cawnpore this would not be less than 15·5 lbs. per cubic foot, which is equivalent to 46·5 lbs., or nine inches of rainfall in the first three feet. Now in June the following rainfalls were received: 13th ·33 inch, 16th ·07 inch, 22nd 3·63 inches, and 27th 0·7 inch. By the end of the month water was percolating from all the gauges. It is certain, therefore, that there must have been at the end of the hot weather a quantity of water equal to about 6 inches or 7 inches of rainfall in the first three feet of the soil.

The quantity of water required by crops is naturally a very important question, and the information we possess is far less accurate than we might wish. A good wheat crop may be assumed to weigh (grain and straw) some 5,000 lbs. per acre in the dry state, and assuming that 250 lbs. of water are transpired by each lb. of crop during growth the total amounts to 1,250,000 lbs. per acre, or 5·5 inches of water. A crop of sugar cane may be assured to transpire probably four times as much. The actual velocity of the minute currents which occur in the soil during wet weather has not been determined. It probably varies very greatly. Data among the Rothamsted records enable one to estimate approximately to what depth the year's rainfall descends in twelve months. Selecting 1893, the year in which the soil of the Broadbylk field was examined, the rainfall was 24·08. The drain gauges showed that of this rainfall 11·84 evaporated and 12·24 penetrated, this having occurred in the absence of a crop. The wheat crop may be assumed to have transpired about 962,000 lbs., equal to 4·28 inches, so that in the Broadbulk field there would only be 7·96 left to percolate. Even after a prolonged drought there is a still a large amount of water in the upper two or three feet of soil. It has been mentioned that in the soil of the gauges at Cawnpore there must have been some 30·35 lbs. of water in the first 3 feet at the conclusion of the hot weather. On the other hand, a heavy crop of corn does not require more than about 20 lbs. per square foot of the field, and yet not even a small crop could have been raised in the hot weather at Cawnpore without additional supplies of water. It seems highly probable that the velocity at which water can move in soils by capillarity is a far smaller one than has been generally supposed. This would explain the fact that plant roots situated at, say, 6 inches below the surface cannot obtain water from a point, say, 9 inches or 10 inches, quickly enough to satisfy their requirements. It would also explain why a single irrigation of, say, 2 inches of water has such a marked effect on a half grown crop after a period of dry weather. Such a quantity of water would rapidly spread itself through fully 8·10 inches of soil by gravity, and the plant would be able to make far greater use of the water than at an earlier period.

INSECT PESTS ON TEA ESTATES.

Mr. E. E. Green, Entomologist to the Ceylon Government, delivered an address before the members of the Maskeliya Planters Association on April 26th last, on insect pests. He described the tortrix caterpillar, whose natural enemies, the Ichneumon flies, were increasing. In one species of these, the grub attaches itself externally to the back of the caterpillar, and behaves like some of the more virulent of the parasites. "At first looking like a tiny greenish head, the grub rapidly increases in size at the expense of its host, which finally collapses and dies, but only when the parasite has no further use for it, and is ready to undergo its own transformation," passing first into the cocoon stage, finally emerging as a tiny four-winged fly with a slender elongated body. The white ant has also occasioned frequent complaint in the Maskeliya district by hollowing out the roots and stems of the tea bushes. It confines its work to the heart of the wood, leaving the active outside tissues untouched, so that the plant remains in an apparently healthy condition until the sudden final collapse, which is often precipitated by a shock or blow. The lecturer stated that this white ant had so far defied all his efforts to unravel its life history; although he had spent hours in making excavations around an infected area he had never succeeded in finding any nests.

Among the least conspicuous, but not least important pests, are the mites, of which four recognised species exist in Ceylon. These are the Indian Red Spider (*Tetranychus bioculatus*), the "ribbed mite" (*Ehylopus carinatus*), the "yellow mite" (*Tarsony-*

mus translucens), and the "scarlet mite" (*Brevipalpus obovatus*). The first mentioned is the least abundant on the tea. It lives exclusively on the upper surface of mature leaves, where it causes distinct rust-coloured patches. The "ribbed mite" is very common and widely distributed, and is responsible for the dull coppery line so noticeable upon tea bushes in the dry season. The "yellow mite" affects the youngest leaves and buds only, and is consequently most destructive to the flush. The signs of its presence are a hard leathery character of the young shoots, and a brownish discolouration of the undersides of the leaves. The "scarlet mite" is, in the lecturer's opinion, the most dangerous of the lot. It attacks under the surface near the base of the leaf, and eventually kills the tissues at this point, causing an extensive and premature fall of leaf. Bushes badly infested by this mite may be denuded of all mature leaves, and show only three or four young leaves at the tip of each twig.

The cause of the injury is too often unrecognised, or attributed to some obscure root trouble. Planters, fortunately, have in powdered sulphur a real specific against all these tea mites, and one that is easily procured and applied. Its effect appears magical. The most economical method of application is by the use of specially designed distributors, casting a fine cloud of sulphur, which settles evenly over the foliage and permeates even the thickest bush. This work can be done on a fine still day in dry weather. A stiff breeze will blow the cloud of sulphur away before it has had time to settle, and a heavy shower will wash it off too rapidly. If there is a heavy dew on the trees this moisture will retain the sulphur firmly on the leaves. Otherwise, it is found advisable to spray the bushes with plain water immediately before the application of the sulphur. The extra cost and trouble are more than repaid by the increased efficiency of the treatment.

About 10 lbs. of sulphur suffices to secure their extermination for each acre. In conclusion, Mr. Green urged the importance of not only always having spraying machines at the different estates, but also stores of various insecticides. The machines when not in use should be kept in working order, and have clean water pumped through them once a fortnight. Coolies should be encouraged to report (and secure specimens of) any insects found upon the tea. The planter should regard every insect as an enemy until certain of its harmlessness.

ENGLISH "ASSISTANTS" IN FRENCH AND GERMAN SCHOOLS.

Last year the French Minister of Public Instruction initiated, in conjunction with the Board of Education, a scheme whereby a number of young teachers (men and women) were appointed temporary "Assistants" for one year in French Lycées and Colleges. The scheme will continue in operation this year, and the French Ministry will shortly proceed to make fresh appointments. It is hoped that similar arrangements may be made with Prussia, with the exception that in this case there will be no posts open to women.

The main duty of the "assistant" will be to conduct small conversation classes for about two hours daily. Though not taking any part in the regular instruction of pupils he will, both in France and Germany, be considered in all other respects as the colleague of the masters. He will not receive a salary, but he will be lodged and boarded at the institution to which he is attached, subject to the provision that in Germany in certain cases a sum of about £65 (Marks 1,300) may be paid to him in lieu of board and lodging.

Candidates for such posts should preferably be graduates of some British University, and should forward their application, containing particulars of their course of study and qualifications, to the Director of Special Inquiries and Reports, Board of Education Library, St. Stephen's-house, Cannon-row, Westminster, S.W., enclosing testimonials in duplicate as to character, capacity, and teaching experience, and a medical certificate of health. It will also be necessary for each candidate to have a personal interview with the Director at his office.

All applications must be received on or before Saturday, the 8th July.

NOTES ON BOOKS.

MODERN CARRIAGES. By Sir Walter Gilbey, Bart. London: Vinton and Co. 8vo.

In this book the author gives an account of the various forms of carriages invented or in use during the Victorian era. In a former work, "Early Carriages and Roads," he dealt with the development of passenger vehicles from the date of their introduction into England until the coaching era.

Sir Walter Gilbey points out that the great improvements which were made in the roads during the earlier years of the nineteenth century naturally produced great changes in the building of carriages. Lighter and more elegant vehicles were demanded, and the clumsy old carriages were superseded. Messrs. Elliott and Holbrook were pioneers of the movement which eventually dispensed with the heavy perch under-carriages, and Mr. Obadiah Elliott's invention of the elliptical spring in 1804 was the foundation upon which many improvements have been built.

The author quotes Mr. Phillipson for the statement that Samuel Hobson, who began his labours about 1820, "may truly be said to have improved and remodelled every sort of carriage which came

under his notice, especially as regards the artistic construction." Travelling carriages, which once occupied the attention of one of the distinct branches of the coach-building trade, have ceased to be required since the introduction of railways. The chariot is another vehicle which has disappeared. It was a handsome carriage, and when used without a driving seat for travelling. it was called a post-chaise. The Brougham, which was first introduced in 1838, had a great effect in driving out the larger and heavier carriages. It owes its introduction to Lord Chancellor Brougham, and the first carriage of this design was built under the personal directions of the inventor, and was finished on May 15th, 1838. The original is now preserved in the Victoria and Albert Museum, South Kensington. The author writes respecting this: "Lord Brougham sold it in 1840 to Sir William Foulis; subsequently it was bought by Lord Henry Bentinck, from whom it was bought by Earl Bathurst. It has been used by many famous statesmen, Lord Beaconsfield and Mr. Gladstone among the number."

Sir Walter Gilbey gives a full account of many other private carriages, which shows how great a variety of designs are still used. Some are adaptations of older vehicles, and others entirely new ones. Of public vehicles he gives the history of the Omnibus. The great genius, Blaise Pascal, is said to have "conceived the idea of running public coaches, each to carry six persons, along certain specified routes" in Paris. With the assistance of influential persons he obtained a royal patent and put seven coaches on the streets. The fare was 2½d., and the Omnibuses were so well patronised that two new lines of route were adopted, and more coaches put on, the fare being raised to 3d. In spite of a certain amount of success the enterprise was given up after two years' experience. Sir Walter gives the date when the idea took practical shape as March, 1662, but it must have been earlier than this, as Pascal died on August 19th, 1662, and previously to his death he had managed the business for a time. The first London omnibus was put on the streets by Mr. Shilibeer in July, 1829. It was drawn by three horses, and carried twenty-two passengers from the "Yorkshire Stingo," near the bottom of Lisson Grove, Marylebone, to the Bank, the fare being 1s. Shilibeer was an undertaker and Thackeray referred in one of his books to the vehicles as "hearses for the living." There had, however, been an earlier venture of the same kind, for *The Public Advertiser* of January 18, 1772, mentions a "new contrived coach" to carry fourteen passengers at 6d. each from Charing Cross to the Royal Exchange.

The author enters fully into the history of the Hansom cab, which has been greatly modified since its original invention by Mr. J. A. Hansom, an architect, who died on June 29th, 1882. The new cab was patented in 1834, and a company was formed for the purpose of introducing it and effecting the needful improvements. In 1836 a fresh patent was taken out in the name of Messrs. Gillett and Chapman.*

Sir Walter Gilbey writes:—"The modern hansom is the combination of improvements devised by many ingenious builders. Mr. Evans of Liverpool, nd Mr. Marston of Birmingham, contributed to the amenities of the vehicle, but the name of Forder is that with which the hansom now in use is most intimately associated." In 1873 the Society of Arts awarded a prize of £30 to Messrs. Forder and Co., of Wolverhampton, for an improved two-wheeled cab.

This interesting account of modern carriages is fully illustrated, and contains much valuable information respecting the history of carriages still in use, and of those once popular but now passed away.

General Description of Sir John Soane's Museum, with brief notices of some of the more interesting works of art. Eighth edition. Oxford. Sm. 4to.

This is an enlarged edition (by Mr. Walter L. Spiers, the present curator) of the official guide to the Museum, and besides a description of the objects exhibited in the house at Lincoln's-inn-fields, it contains a series of ten illustrations of some of the chief treasures of the institution, such as Hogarth's pictures of the Election and the Rake's Progress, pictures by Turner, Canaletto, and Watteau, as well as the splendid alabaster sarcophagus of Seti I., King of Egypt about 1370 B.C., which was discovered by Belzoni in 1817.

The Practical Electrician's Pocket-book for 1905. Edited by H. T. Crewe. London: S. Renteli and Co., Ltd.

This little book is now in its eighth year, and besides a large amount of practical information for Electrical engineers brought up to date, it contains anditional sections on Steam Turbines and Alternators, and the section devoted to Polyphase machinery has been extended.

OBITUARY.

James Mansergh, F.R.S.—Mr. Mansergh, who died at his residence in Fitzjohn's-avenue, on the 15th inst., was a member of the Society of Arts since 1873, and specially interested in the work of the Society in connection with sanitary matters and water supply. At the Sewage Conferences of 1876 and 1878 his external drain trap was exhibited by Messrs. Doulton, and before the Conference on Water Supply held at the International Health Ex-

* These particulars are stated in an article in the *Journal*, from information received from Mr. Hansom (March 28th, 1873, vol. 21, p. 360).

hibition, he read a paper on "Sources of Water Supply," in July, 1884 (*Journal*, vol. xxxii., p. 870).

Mr. Mansergh was born at Lancaster, in April, 1834, and was educated at two private schools before he joined Queenwood College. Here he was for a time co-editor with Mr. Henry Fawcett (afterwards Postmaster-General) of the *Queenwood Chronicle.* In 1849 he became a pupil with Messrs. McKie and Lawson, Civil Engineers, of Lancaster. About 1855 he set sail for Brazil, in the capacity of contractor's engineer and district agent, being one of four employed on the first section of the Don Pedro II. Railway, which connected Rio de Janeiro with the interior. His three companions were invalided and he alone remained to finish the plans. He returned to England and joined in partnership with his late chief, Mr. McKie. This partnership continued for three years, after which he came to London and undertook a large main sewerage contract at West Ham. The undertaking with which Mr. Mansergh's name is more especially connected is that of the Elan Valley Water Scheme for Birmingham which was opened by the King in 1904, and it is said that when as a young man he was travelling in the district he first conceived the idea of this great undertaking.

Mr. Mansergh was elected a Fellow of the Royal Society in 1901. He became an Associate of the Institute of Civil Engineers in 1859, a member in 1873, a member of Council in 1884, a Vice-President in 1895, and President in 1900.

GENERAL NOTES.

TRADE WITH BOLIVIA.—In his report upon the trade of Bolivia for 1904 (3388, Annual Series), Mr. Consul Harrison says that British manufacturers would do well to send their catalogues in the Spanish language, indicating weights, measures, prices, discounts, and every possible detail, as is done by competing countries. Another step that should be taken by manufacturers of mining machinery and tools of every description is that of the establishment of depots or agencies at Oruro, the most important mining centre, and at Autofagasta, its port. It is also desirable that all machinery should be made in sections to facilitate the transport by mule back, as the roads in the country are very rough and hilly, and do not permit the traffic of carts. The weight of any package should not exceed 350 lbs. Vice-Consul Mr. E. F. Moore, writing upon the trade of the Sucre district, says it is impossible to over-estimate the value and importance of issuing catalogues, price lists, and pamphlets printed in Spanish, and, if possible, properly illustrated, to bring before the notice of a very conservative people new articles and modern types of all household use. "I frequently meet people," writes Mr. Moore, "in a position to buy who will not look at anything printed in English It is really diverting to see how the American patent medicine makers have literally imposed their goods by means of picturesque and really attractive advertisement sheets and other contrivances almost played out in the Old World. The lower classes decorate their rooms with these sheets, and have them before them until the article which they propose to bring before the consumer literally becomes a by-word."

TEA CULTIVATION IN JAVA.—Some months ago attention was directed in the *Journal* to the probability of Java becoming in course of time a serious competitor in the tea markets of the world, and Mr. Consul Fraser's report (3403, Annual Series) on the trade of the island in 1904 supports this view. The tea exports have more than doubled in the last ten years, from 12,841,720 lbs. in 1899 to 25,375 691 lbs. in 1904. Last year the exports were increased by over 3,000,000 lbs. as compared with 1903. A large area of new land has been laid out for tea cultivation with Assam seed, which insures a further increase of quantity to be disposed of in the near future. Of the exports in 1904 more than half, 13,102,916 lbs., went to the Netherlands, the United Kingdom taking 9,918,408 lbs. of the remainder, Russia, Singapore, and Australia taking nearly all the rest. A feature of the year has been the establishment of a tea market at Batavia, three firms having started business, while several of the local houses contemplate taking up the trade.

EXHIBITION OF PROCESS ENGRAVING.—The loan collection of examples of process engraving, comprising photogravure, photo-lithography, and kindred reproductions by means of photography, which has been on view for the past three months at the Victoria and Albert Museum, South Kensington, will be closed on Sunday, 25th instant.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 26... United Service Institution, Whitehall, S.W., 3 p.m. Mr. E. Ashmead Bartlett, "The Siege and Capitulation of Port Arthur."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

TUESDAY, JUNE 27...Hellenic, in the Rooms of the Society of Antiquaries, Burlington-house, W., 5 p.m. Annual Meeting.

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. S. Rosenbaum, "A Contribution to the Study of the Vital and other Statistics of the Jews in the United Kingdom."

WEDNESDAY, JUNE 28...SOCIETY OF ARTS, John-street. Adelphi, W.C., 4 p.m. Annual General Meeting.

Church Crafts League, Church-house, Dean's-yard, S.W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W. 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JUNE 29...Antiquaries, Burlington-house, W., 8½ p.m.

Journal of the Society of Arts.

No. 2,745. VOL. LIII.

FRIDAY, JUNE 30, 1905.

NOTICES.

H.M. THE KING OF SPAIN.

The Council of the Society having elected H.M. the King of Spain an Honorary Royal Member, H.R.H. the Prince of Wales, as President of the Society, graciously communicated to King Alfonso the fact of his election, and has now received from His Majesty the following letter of acceptance :—

MONSIEUR MON COUSIN :—Le plaisir que Votre Altesse Royale veut bien trouver à Me prier de faire partie de la Society of Arts, en qualité de Membre Royal Honoraire, n'est certes pas moindre que celui que j'éprouve en acceptant cette distinction.

Je me considère fortuné de pouvoir inscrire Mon nom sur les listes où figurent déjà d'autres si illustres, et surtout ceux de l'Auguste Père de Votre Altesse Royale, Sa Majesté le Roi Edouard VII. dont je viens de recevoir l'hospitalité généreuse, et de son Aïeul vénéré et éclairé le Prince Consort d'heureuse mémoire.

La sphère d'action choisie par la Corporation insigne dont Votre Altesse Royale m'ouvre les rangs m'est d'ailleurs bien connue. J'en approuve et admire hautement les travaux, et serai fier d'y appartenir sous la présidence de Votre Altesse Royale, à laquelle Je suis charmé de renouveler l'expression des sentiments d'amitié vive et sincère, avec lesquels je suis

Monsieur Mon Cousin
de Votre Altesse Royale
le Bon Cousin
(Signed) ALFONSO, Rex.

Au Palais de Madrid,
le 14 Juin, 1905.

A Son Altesse Royale le Prince de Galles.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the Gardens of that Society, Inner-circle, Regent's-park, on Tuesday evening, the 4th of July, from 9 to 12 p.m.

The central portion of the Gardens only will be used. The Gardens will be illuminated with coloured lamps, and also by the Kitson Incandescent Oil Light. The Conservatory and the Club-house will be open.

The Reception, by Sir William Abney, K.C.B., F.R.S., Chairman, and the other Members of the Council, will be held at the entrance to the Conservatory, near the Broad Walk, from 9 to 10 o'clock.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross.

A Selection of Music will be peformed by the String Band of the Royal Artillery in the Conservatory, and by the Band of H.M. Grenadier Guards in the Gardens, commencing at 9 o'clock.

Two performances of Selections from Pastoral Plays will be given in the Gardens by Mr. Patrick Kirwan's Idyllic Players at 9.30 and 10.45 p.m.

A concert and entertainment, including a scene from "The School for Scandal," will be given in the Club-house, from 10 to 10.45 p.m.

Light refreshments (tea, coffee, ices, claret-cup, &c.) will be provided.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These cards have now been issued. A limited number of tickets will also be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the Conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers, was held, in accordance with the By-laws on Wednesday last, the 28th inst., at 4 p m., Sir WILLIAM ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., Chairman of the Council, in the chair.

The SECRETARY read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, ballotted for, and duly elected members of the Society:—

Allfrey, Edward W., 2, St. Michael's-chambers, Oxford.

Bardill, W., Hildon-house, Wantage, Berks.

Bell, Sir Hugh, Bart., Rounton-grange, Northallerton, and 95, Sloane-street, S.W.

Benn, Alfred William, Il Ciliegio, San Gervasio, Florence, Italy.

Bodine, Samuel T., Broad and Arch-streets, Philadelphia, Pennsylvania, U.S.A.

Boulding, Sidney, M.I.Mech.E., 28, New Bridge-street, E.C., and Elcombe, Alleyn-road, West Dulwich, S.E.

Britten, W. E. F., Fulcher's Atelier, Bourne, Lincolnshire.

Chesterton, Fred., Messrs. G. and A. Brown, Limited, 167, Hammersmith-road, W.

Evans, B. P., The Schools, Treharris R.S.O., Glamorgan.

Faulkner, Alfred Robert, Fairholme, Worple-road, Wimbledon.

Foster, Edward William Percival, C.M.G., 7 Rue des Ptolemées, Alexandria, Egypt.

Hamburger, Arthur, Remilly, Pendle-road, Streatham, S.W.

Hartfree, George Bertram, Ackenden-road, Alton, Hants.

James, C. Boucher, 552, Oxford-street, W.

Keys, Samuel, Star Encaustic Tile Company, Bluff-street, Pittsburg, Pennsylvania, U.S.A.

Knowles, Mrs. Marian, 24, St. Edmund's-terrace, Regent's-park, N.W.

Lal, Prof. Ganeshi, B.A., Kayestha Pathshala, Allahabad, India.

Leonard, Charles Henry Brandt, 18, Kensington-palace-gardens, W.

Macaura, Gerald Joseph, M.D., 4 Spring-bank, Bradford.

Macpherson, Archibald, 171, Auckland-hill, West Norwood, S.E.

Master, Lieut.-Colonel R. Chester, The Residency, Salisbury, Rhodesia, South Africa.

Miller, Sir James P., Bart., D.S.O., 45, Grosvenor-square, W.

Moore, Alfred Ernest, B.A., B.Sc., F.C.S., Escuela Regional, Corrientes, Argentine Republic.

O'Shaughnessy, Hugh Patrick, Executive Engineer, South Indian Railway, Trichinopoly, India.

Palumkote, Miss Baiai Limjibhoy, Grant-road-bridge, Grant-road, Bombay.

Philip, Joseph, Dalmore, Westpark-road, Dundee.

Potter, Edward C., The Rookery, Chicago, Illinois, U.S.A.

Reid, Ernest John, 7, Western-villas, New Southgate.

Sanford, Miss S. Ellen, The Holme, Clifton Hampden, Abingdon.

South, Ernest H., Warwickshire Estate, Hunyani River, Mashonaland, Rhodesia, South Africa.

Sykes, Oliver Wyatt, 303, Bow Bazar-street, Calcutta, India.

Tate, James C., c/o United Lankat Plantations Co., 2, Tokenhouse-buildings, E.C.

Thakado, Maung, K.S.M., Prome, Lower Burma.

Thoresby, Frederick, 1, Queen Victoria-street, E.C.

Tompkins, Engineer Commander Albert E., R.N., Royal Naval College, Greenwich, S.E.

Vaughan, James Christopher Mason, 27, Commercial-street, Hereford.

Vernon, William Henry, The Laurels, Livingstone-road, Birchfield, Birmingham.

Wadia, N. P. N., 16, Trebovir-road, Earl's-court, S.W.

Wilkins, Thomas Henry, 9 Dunedin-house, Basinghall-avenue, E.C.

Wills, Edward Chaning, M.A., F.C.S., Eastdown-house, near Barnstaple.

And as Honorary Corresponding Members:—

Hansen, Prof. Emil Chr., M.D., Copenhagen, Denmark.

Pictet, Raoul, Geneva, Switzerland.

Rontgen, William Conrad, Munich, Bavaria.

Thomson, Prof. Julius, Ph.D., M.D., For. Memb. R.S., Copenhagen, Denmark.

Van de Waals, Prof. R. J. D., Amsterdam, Holland.

The CHAIRMAN nominated Mr. THOMAS BURNS and Mr. JOHN HUME scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—The London Institution and the Society of Arts.

The most important matter relating to the interests of the Society itself which the Council have had before them during the past year was the proposal for an amalgamation between the Society of Arts and the London Institution. An account of the proposal is given in a memorandum which was printed by order of the Council in the *Journal* for the 31st of March last, but it may be desirable to put on record in this Report what the proposal really was, and what action the Council took.

The matter first came formally before the Council on November 21st last, when a letter was read from the Board of Managers of the London Institution stating that they had appointed a Committee to consider the proposal, and to confer with any Committee which the Council of the Society might appoint. The names of the two Committees are given in the memorandum above referred to, but the Council think it right to mention that they are specially indebted to the Lord Chief Justice for the active personal interest which he took in the matter. He attended all the meetings of the two Committees, and took an active part in the preparation of their Report.*

This Report recommended the amalgamation of the two Institutions into a single body, and suggested the terms upon which such an amalgamation might be arranged. It was proposed that the objects specified in the Charters of the two Institutions should be carried out to the full; that the Proprietors of the London Institution should become permanent members of the new Corporation, and that the powers they now possess of transferring or bequeathing their rights should be continued in perpetuity, but that they should be relieved from the annual payment of Two Guineas at which they are now assessed. Provision was suggested for the case of any Proprietors who preferred to resign, by providing that any such Proprietor might receive a sum of £25 in discharge of his claims, an amount which was understood to be much above the price at which shares have lately been sold. Life members of the Society of Arts would have become life members of the new Institution. Annual subscribers would have continued their membership on the same terms as heretofore. The Governing Body was to be formed in the first instance by a combination of the Society of Arts Council and the Board of Managers of the London Institution, provision being made for the election hereafter of a suitable Governing Body.

The Ordinary meetings of the Society of Arts were to be continued on the same lines as heretofore, and the Sectional meetings were also to be carried on. The Society's examinations were to be continued. The *Journal* of the Society, now in its 53rd annual volume, was still to be published, probably in an extended and enlarged shape. The lectures which are now held at the London Institution were to be continued, and it was suggested that by a judicious expenditure upon the fine library of the London Institution, it might be brought up to date, and a scientific library produced of the highest character. The maintenance of the circulating library was recommended, though it was considered that fresh purchases should be limited to works of a scientific and technical character. It was also suggested that scientific and industrial research might be carried out, as was formerly the case with the London Institution when its resources permitted. The Report discussed the question of a new building, which would afford for the members of the new Institution accommodation on a more extensive scale than is now provided by either of them.

It was thought also that certain other societies would be inclined to unite in a scheme for a large building providing independent accommodation, and it was known that several of the less wealthy London societies would gladly have availed themselves of offices which could readily have been provided in a building such as was contemplated.

It was originally thought that arrangements might be made for effecting the amalgamation by a surrender of the separate Charters and an application to the Crown for a fresh Charter: but on Counsel's opinion being taken it became evident that such a proceeding was not a possible one. No provision exists in the statutes of either body for winding up the Institution, and it appears certain that the Charter could only be resigned with the unanimous consent of every member of each Corporation. The Committee were, therefore, advised by Mr. R. J. Parker, whose opinion they sought, that the simplest and best way of carrying the amalgamation into effect was to promote a private Act for the purpose.

* This Report was not printed in the *Journal*, but copies were sent to members of the Society desiring them. Any member wishing to read the Report can be furnished with a copy.

It was believed that the scheme suggested provided fairly and liberally for the members of the two Institutions alike, that it would give to those composing the new body all that the members of either Institution had received, and something in addition, so that the advantage alike to the members of the London Institution and of the Society of Arts would be equal. The Report was in due course submitted to and approved by the Council of the Society and the Board of Managers of the Institution, His Royal Highness the President of the Society, without whose consent of course no action could be taken in the matter, also approved the proposal.

It was naturally expected that the scheme would be cordially accepted by the General Meetings of the two Institutions. But when it was propounded to a special General Meeting of the London Institution, it was, rather to the surprise of all who had been concerned in its preparation, received with a somewhat violent opposition. Objections were taken to the removal of the Institution from the City, and representations were made, which seemed to be accepted as the truth by at all events a proportion of the Proprietors, to the effect that the whole scheme was in the interests of the Society of Arts, and that the Proprietors of the London Institution were giving up a fine property to be applied to objects in which they had no interest, and dealt with by a body over which they had no control. Eventually no decision was arrived at at the meeting, but a Committee was appointed to confer with the Board of Managers.

As soon as the Council of the Society of Arts were apprised of the result of this meeting, they at once decided that a project of this nature could not be dealt with in the spirit with which it seemed to have been approached by those who opposed it, and that it was better to abandon the scheme, so far as they were concerned, rather than to attempt to force it through against even a minority of the Proprietors of the London Institution. They, therefore, passed the following resolution, which was published in the *Journal* of May 12th :—

"In view of the feeling which appears to have been aroused amongst some of the Proprietors of the London Institution with regard to the proposed amalgamation with the Society of Arts, and the consequent probable difficulties of effecting a harmonious fusion of the two Corporations into a single Institution, the Council of the Society of Arts have decided not to take any further action in the matter, and hereby discharge the Committee which, at the instance of the Board of Managers of the London Institution, they appointed to consider the scheme for amalgamation."

Although they had accepted the original proposal with a certain amount of hesitation arising from the fear that the successful work which the Society has now so long carried on might suffer from an attempt to occupy the much larger field covered by the London Institution and the Society of Arts together, they yet felt that an Institution such as was contemplated, sufficiently endowed and properly directed, might be of the greatest public service, and that London would be provided with a powerful organisation devoted to Science, Art, Literature, and Education, which ought to be able to hold its own with any similar Institution in any part of the world. But they thought that the successful foundation and maintenance of such an Institution demanded the harmonious co-operation of all concerned, and that it was better to remain satisfied with the present condition of the Society rather than to attempt to force against opposition, whether powerful or weak, whether judicious or ill-advised, so difficult and complicated an undertaking as the organisation of a new Institution of the importance desired. If as the result of a conference, which is presumably to be held between the Board of Managers of the Institution and its Committee, any fresh overtures should be made to the Society, they will always be cordially welcomed and carefully considered; but the Council do not propose to take any further action themselves, or to bring the matter formally under the consideration of a General Meeting of the Society.

II.—Ordinary Meetings.

In accordance with the usual practice, the Session was opened with an address from the Chairman of the Council, Sir William Abney. In his previous address Sir William had dealt with the question of Commercial Education and the examinations of the Society, and had made an estimate, based on the examination results of previous years, of the numbers of candidates who might enter in future years for these examinations. So far as Sir William Abney's anticipations have yet gone, they have been more than realised, for whereas he expected 21,400 candidates for the present year, the actual number of entries was 25,951. In his Address last November, he discussed

the general question of the relation of Societies and private Institutions to the State, and indicated certain departments of scientific work, now being carried out by private enterprise, which could be more effectively and better dealt with by the State.

The first regular meeting of the Society after the opening meeting was devoted to a paper by Mr. B. H. Morgan, on "The Systematic Promotion of British Trade." Mr. Morgan described to the Society a scheme he had devised for familiarising British subjects resident in the Colonies with the condition of British industries by means principally of an organised system of lectures to be delivered in colonial centres, dealing with the different branches of British manufactures, and pointing out the requirements of British trade.

In his paper on "The Canals Problem," read at the second meeting of the session, Mr. Arthur Lee dealt with a topic which has not infrequently been before the Society, and once more urged the importance of a consideration of the neglected waterways of the kingdom.

In the next paper Mr. W. F. Reid gave an interesting account of the British Section at the St. Louis Exhibition, and showed that the contributions of Great Britain, though not in all respects equal to its contributions to some of the former great International Exhibitions, were yet, as a whole, worthy of the country. Although the leaders of many branches of British industry hesitate to incur a certain expense for a problematic and inadequate return, it is yet satisfactory to know that in some departments at all events, especially that of Industrial Chemistry, the country was worthily represented. It is not a little remarkable that this department should be the one in which in previous exhibitions Great Britain has always made but a poor appearance. This was a proof of what has often been said of the necessity for co-operation amongst the exhibitors themselves. They are not quite ready to realise that it is less important that individual firms should make a good show than that the country should be well represented in any special branch of industry. The rewards of such exhibitions go not only to the individuals who have contributed to it, but also to the trade in general.

At the last meeting before Christmas another topic familiar to the Society was discussed, when Mr. C. D. Abel read a paper on "The Patent Laws," dealing especially with the new Act, which has since the 1st of January come into force. As the Society was largely interested in the movement which led to the first reform of the Patent Laws in 1852, and was mainly instrumental in bringing about the second important Act in 1883, any paper on this subject read at the Society of Arts naturally attracts a good deal of attention, and this was the case with the valuable contribution from Mr. Abel.

At the first meeting after Christmas a paper of very great interest was read by Captain Lionel James, who gave an account of his own attempts to organise, probably for the first and last time, a system of journalistic war correspondence by means of wireless telegraphy. The experience of Captain James, as the correspondent who reported to *The Times* the earlier performances of the Japanese in naval war, can hardly be repeated, for it is unlikely in the future that any such attempt to transmit news by wireless telegraphy will ever be permitted by naval combatants.

The paper which followed on "London Electric Railways," by the Hon. Robert P. Porter, was remarkable not only for the account it gave of the present condition and future prospects of such railways in London, but also for the great amount of information which Mr. Porter had collected about similar enterprises in other countries, especially in the United States, where the cities of New York and Chicago have in many respects set an example to London.

In the next paper Sir William Preece, who had been led in the course of a recent visit to Egypt to pay special attention to the navigation of the Nile, read a most interesting paper on that subject. The information supplied by Sir William Preece was usefully supplemented by the remarks of the Chairman of the meeting, Sir Robert Hanbury Brown, who is responsible for much of the work which has lately been carried out on the Nile.

The very popular subject of Photography was next dealt with by Mr. R. Child Bayley, whose paper was an account of the manner in which mechanical methods of time development have to a large extent superseded the older forms of photographic development. It is not a little strange that a scientific process, the success of which was for so many years considered to depend upon the personal skill and ingenuity of the operator, can now be carried out in such great perfection by purely mechanical means. Mr. Child Bayley's account of the methods by which these results

have been obtained appealed alike to the most skilful operators and to those who have been led to the practice of photography by the modern facilities for carrying it out.

Some original views as to the decline of the country town and the migration of the population into the great cities was put forward by Mr. A. H. Anderson in his paper on that subject, a paper which was the result of a good deal of careful and ingenious research. On the following Wednesday, Mr. J. E. Borland dealt with what he termed "Some Misconceptions of Musical Pitch." Mr. Borland dealt with the inconveniences of modern notation, the difficulties caused by the necessity for transposition in orchestral scores, and, generally, the desirability of adopting some more logical and sensible system than the one at present in use.

A reference has been previously made to the paper by Mr. W. F. Reid on the St. Louis Exhibition, so far as refers to the commercial side. This paper was most usefully supplemented by Mr. Isidore Spielmann, who gave a very full account of the British Art Section, a section in which this country admittedly held its own with any other, and one which contained probably the finest collection of pictures ever sent from Great Britain to any foreign exhibition.

At the next meeting, the Society was fortunate in hearing from an eminent Japanese some account of the ethics and morals of that remarkable country in the paper read by Baron Suyematsu on "The Ethics of Japan." It was not until the war was well in progress that much attention was drawn to the systems of Japanese morals by a very able article in *The Times*, and by some articles contributed by Baron Suyematsu himself to the *Nineteenth Century*, and some other magazines. Baron Suyematsu's paper, together with the articles referred to, may be said to have helped to teach the people of this country the true nature of the character of the Japanese, and helped to explain all their wonderful recent successes. At this meeting Lord Redesdale, who as Mr. Percy Mitford was the first to introduce the history of Japan to popular knowledge in his tales of "Old Japan," was in the chair.

In his paper on "Methods of Design in Mohammedan Art," Dr. E. H. Hankin put forward some new ideas as to the origin of the exquisite and complicated designs which form so principal a feature of Indian Mohammedan Art. Though some of the speakers in the discussion were not quite prepared to admit the full accuracy of Dr. Hankin's suggestions, they yet bore testimony to their value, and admitted the light they shed on this particular branch of decorative art.

Last year Sir Charles Kennedy read a most instructive paper on the Fiscal Question, and in a second paper read at the end of March last he brought this difficult question up to date. Sir Charles Kennedy's treatment of the subject, as was suited for the Society, was purely statistical, and he left on one side the thorny difficulties of Free Trade and Protection.

Of recent years the Society has had many valuable contributions on the subject of British Forestry, and very various views have been expressed by such authorities as General Michael, Dr. Schlich, and Mr. D. E. Hutchins. In his paper on "British Woodlands," Sir Herbert Maxwell dealt with the question from the point of view not of the expert, the forester, or the trader in timber, but of the landlord, and he endeavoured to impress on his audience and the public, as 150 years ago the Society endeavoured to impress it on the landowners of that date, the importance of growing timber in a scientific manner, and the profit to be derived from its cultivation.

Considerable interest was aroused some few years ago by the late Mr. Theodore Bent when he drew attention to the ancient remains which exist in South Africa, and the details of the ancient architecture of the great Zimbabwe in Rhodesia which Mr. R. N. Hall gave in his paper, were followed with great interest by those who heard the paper, and by many readers of the *Journal*.

In his paper on "The Industrial Resources of the State of Matto Grosso, Brazil." Mr. G. T. Milne drew attention to a country which, though it cannot be said to be little known, has yet never received the attention it deserves. The industrial resources of the interior of South America, both mineral and agricultural, are only now beginning to be realised, and Mr. Milne's able contribution to our very limited knowledge of the subject was therefore very welcome.

This brings the record of the Society's meetings for the session down to Easter. At the first meeting after Easter Mrs. Burton-Brown gave an instructive account of the recent excavations in Rome, and showed a number of photographs illustrating the work which has lately been done in the exploration of the Forum. In the following week Lord Mountmorres put on record the results of his recent journey in Central Africa up the Congo to its junction

with the Ubangi, then up the Ubangi and overland by a devious route, which touched the Uganda border, back to the Congo again. The accounts given of the different races with whom Lord Mountmorres came into contact are of very great interest. They were fully illustrated by photographs of the people and their abodes.

A valuable technical account of the "Uses of Wood Pulp in Paper-making" was given by Mr. S. C. Phillips, whose knowledge of this subject is perhaps unrivalled. The sources from which the main supplies come, and the method of their treatment, mechanical and chemical, were fully dealt with, and some useful statistics brought down to the latest date completed the paper.

At the last meeting of the Session Mr. Killingworth Hedges gave an account of the work of the Lightning Rod Committee, a body which was appointed a few years ago to bring up to date the work of the Lightning Rod Conference, the report of which was published in 1881. Since then a good deal has been learned about the action of lightning, and the results of this new knowledge, which are set out in detail in the Report of the Committee, were clearly and usefully summarised by Mr. Hedges, who had acted as Honorary Secretary of the Committee, and to whose exertions the Report was to a very large extent due.

III.—Indian Section.

In the thirty-seven years that have passed since the Indian Section was established, Secretaries of State, ex-Viceroys, and retired Commanders-in-Chief, have been amongst the distinguished men who, by presiding at its meetings, have shown their appreciation of the work systematically and continuously performed by the Society of Arts on behalf of our great Eastern Empire. To these statesmen, administrators and soldiers, must now be added an eminent Indian feudatory in the person of the Maharaja Sir Sayaji Rao, G.C.S.I., Gaekwar of Baroda. The occasion upon which for the first time an Indian reigning prince has taken the chair at a meeting of this or perhaps any other learned society in London was the reading by Mr. H. J. Tozer of not the least valuable of the series of papers jointly organised by the Indian and Colonial Committees, and dealing with a subject of acknowledged Imperial importance, namely, the manufactures of Greater Britain. The value of Mr. Tozer's comprehensive survey was enhanced by the fact that during a recent visit to India he spent some time in making himself personally acquainted with the existing industrial conditions in Calcutta, Bombay and other commercial centres. He demonstrated that while India more than any other portion of Greater Britain gives the Empire its imperial character, and may justly claim the first consideration after the United Kingdom itself, the "oft-predicted outburst of industrial activity" has not yet arrived, and that for a long time to come the manufacture of produce now exported raw will probably be the most fruitful sphere of effort. In the discussion, Sir George Watt, speaking from his special experience, maintained that the industries of India will never be able adequately to compete with European manufactures unless the present antiquated methods are abandoned, and development made on modern or European lines.

Early in the Session when the results of the Younghusband expedition were engaging much attention, Mr. Douglas Freshfield, the intrepid mountaineer, read a very interesting paper to a distinguished audience, on "The Gates of Tibet," as he aptly described the State of Sikkim. Numerous photographic views of the magnificent scenery of Sikkim were shown on the screen, and charmingly described by the author, who incidentally advocated the despatch of an exploring party down the Brahmaputra with the twofold object of solving certain geographical problems, and opening up the eastern extremity of Tibet.

Plague in its medical and technical aspects has frequently been treated, but in the able and elaborate paper contributed by Dr. Charles Creighton, the epidemic now raging with increased virulence in Northern India, was described from a more general standpoint. At the cost of the research fund, known as the Leigh-Browne Trust, the author of the well-known "History of Epidemics in Britain" went to India towards the end of last year for the purpose of learning something of the actual conditions of plague, and the paper read by him a few weeks after his return to England embodies the results of his painstaking and rather extensive inquiries. It also advanced certain theories as to the causes of plague in India, especially in the mud built villages of the plains, theories that were not entirely accepted by one or two of the scientific experts who took part in the full and useful discussion on Dr. Creighton's paper.

In the Session before last Mr. J. A. Baines

read a paper entitled, "Gleanings from the Indian Census of 1901," in which he treated, with his characteristic lucidity and skill, the statistics then available. The Census report itself "contained in three large quarto volumes besides about 60 subsidiary volumes for the different provinces" was issued last year, and by desire of the Committee Sir Charles A. Elliott contributed a paper at the earliest possible date on some of the more important points, ethnological, linguistic, &c., elucidated in the monumental record of the labours of Mr. Risley and his coadjutors. One of the latter, Dr. G. Grierson, was present at the meeting, and took part in the discussion on Sir C. Elliott's interesting and informing paper.

To the series of papers on the Provinces and Capitals of India, a welcome addition was made by Sir Frederic Fryer, whose authoritative description of the province of which he was the first Lieut.-Governor admirably supplements the paper on "British Burma under British Rule," given to the Society some years ago by his successor Sir H. Thirkell White.

Of the remaining papers, one by Sir J. George Scott was on "The Prospects of the Shan States," and the other by Mr. T. C. Hodson on "Manipur and its Tribes." Both may be regarded in a sense as complementary to the papers of Sir Thirkell White and Sir Frederic Fryer, and as forming, together with the paper on Assam given to the Society in 1903 by Sir Charles Lyall, a very complete account of the interesting States forming the north-eastern fringe of the Indian Empire.

IV.—Colonial Section.

The Session opened with a singularly able paper on "British Commercial Prospects in the Far East," by Mr. Byron Brenan, C.M.G., late H.B.M. Consul-General at Shanghai. For want of time and other reasons Mr. Brenan confined his remarks to China, and it is hoped that the other States forming what is known as the Far East will be dealt with later in an equally comprehensive manner either individually or collectively. Mr. Brenan showed that if we are to hold our own in China it is necessary that the British manufacturer must "wake up." Indeed he says, "It will require more energy than we are now displaying, and also a change of tactics, if we are to improve, I do not say only to the same extent but in the same ratio as the others." British firms, he tells us, grow less in number, and ur European competitors fill the gap. When a new opening presents itself the rival is quicker to seize the opportunity. Our share in new railway projects does not seem quite satisfactory; but Mr. Brenan considers that British capital can be best employed in the exploitation of China's immense mineral resources—when the Pekin authorities can be induced to redeem the promise they made to Sir James Mackay to introduce reasonable mining regulations. Not the least instructive portion of the paper was that in which Mr. Brenan discussed the probable effects of the present Russo-Japanese war on the commercial future of China.

Reference has been made above to the series of papers on "The Manufactures of Greater Britain." The original idea was to have one paper for the whole of the Empire beyond the seas. This, however, was found to be impracticable, and so it was decided to deal with the subject piecemeal. As already mentioned India formed the subject of one paper. The Dominion and the Commonwealth were also treated separately. The excellent Canadian paper was contributed by Mr. C. F. Just, a well-known London official of the Dominion Government, and the equally admirable Australasian paper by the Hon. Walter James, K.C., Agent-General for Western Australia, and formerly Premier of that colony. The preparation of these exhaustive papers involved great labour, and the Society is much indebted to the authors for the trouble they took in the matter. The Society has been officially requested to include the West Indies in the series, and the suggestion will be considered.

A paper on "The Cape to Cairo Railway" had been promised by Sir Charles Metcalfe for the concluding meeting, and had been anticipated by the members of the Society and their friends with considerable interest. It had, however, to be postponed at the last moment owing to the sudden indisposition of Sir Charles Metcalfe.

V.—Applied Art Section.

At the first meeting of the Section in December last, Mr. T. G. Jackson, R.A. read a valuable paper on "Street Architecture," in which he alluded to symmetrical design in street architecture as applied to towns generally, and the changes necessitated by the universal use of iron construction in the formation of shop-fronts. He then specially referred to the rebuilding of the Strand, between Wellington-street and the Courts of Law, and advocated

some change in the present frontage line, at the same time pointing out the great danger of allowing buildings to rise to such a height as to dwarf the proportions of the two churches which divide the road. There was an animated discussion on the whole question, and the discussion was continued in *The Times* and other newspapers.

At the second meeting, Mr. Edward Johnston and Mr. Graily Hewitt read two papers on "Calligraphy and Illumination." Both authors urged the advantages of special attention being drawn to the improvement of ornamental handwriting and a return to the best models of the past, showing that in art there was still room for the making of manuscript books which should be distinguished by clearness of lettering. In the discussion that followed the reading of the papers, the speakers generally agreed with the opinions of the authors, and those competent to express the opinion held that as printing at its invention owed everything to writing, so the art of type founding, which was constantly tending towards a fixed form, might be improved by attention being paid to the best pen-forms.

In his exhaustive paper on the Queen Victoria Memorial as compared with other royal memorials abroad, Mr. Marion Spielmann passed in review a fine collection of views of the chief royal memorials of the world, and then explained the plan of the Queen Victoria Memorial in the Mall of St. James's Park, and illustrated it by views of the architectural design of Sir Aston Webb, R.A., and the sculptures by Mr. Thomas Brock, R.A. Mr. Spielmann explained that it was feared want of funds would prevent the whole of the grand scheme of the Processional Road from being carried out.

Mr. F. Bligh Bond, in an interesting paper on "West Country Screens and Rood Lofts," gave a full description of these remarkable architectural ornaments which are so frequent in the churches of Devonshire. In the discussion, reference was also made to the fine screens in the Eastern counties, and the question was raised as to whether the workmanship was due to foreign or English craftsmen. Mr. C. E. Keyser contributed a series of coloured illustrations of saints' and other figures on the church screens of the country.

Mr. Starkie Gardner's historical paper, "Monumental Treatment of Bronze," was in continuation of a former paper on the same subject. In 1888 he dealt with sepulchral monuments, and in the present one he treated of equestrian statues and bronze doors, illustrated by an important series of views of the finest Italian monumental art. The early doors, of which a large number of representations were shown, consisted of small panels. The famous artist, Ghiberti, was the first to abandon the strongly constructional form and introduce larger panels, a fashion generally adopted, so that frequently the great gates of the later period were made up of only three panels to a leaf.

The last paper of the Session was that on May 20th, by Mr. H. R. Hall, on "The Excavation of the Oldest Temple of Thebes."

The second temple at Deir el-Bahari, which is now being excavated by Professor Naville, under the auspices of the Egyptian Exploration Fund, stands side by side with the first temple excavated some ten years years ago by him. This second temple is a thousand years older than the first discovered temple, and dates from the time of the Eleventh Dynasty (about 2500 B.C.). Mr. Hall, who has taken part with Professor Naville in the excavation during the last two seasons, gave a fully-illustrated account of the course of proceedings by which this important work has been successfully carried out.

VI.—Cantor Lectures.

The first course of Cantor lectures was on "Musical Wind Instruments," by Mr. D. J. Blaikley. Mr. Blaikley, who is connected with the well-known firm of Boosey and Co., is recognised as an authority on the subject, and his lectures were well attended by many who were specially interested in it. His own practical skill as a performer enabled him to give many illustrations on various instruments, but he also secured the assistance of several well-known performers who provided illustrations in solo and concerted music. The lecturer dealt very thoroughly with the subject, beginning with an explanation of the acoustical principles on which all wind instruments depend for their action, and in the following lectures describing the three classes into which all wind instruments may be divided—brass, reed, and flutes.

In the second course, Mr. J. P. Maginnis gave a very full and detailed account of the various inventions which have resulted in the production of modern stylographic and fountain pens. Few who use this now popular instrument can have any idea of the amount of ingenuity which has been devoted to its development, or of the attention, as exemplified by the number of patents which have been

taken out, which has been given to it, until it assumed its present finished shape.

Mr. Dugald Clerk's course on "Internal Combustion Engines" attracted a large and interested audience of students of engineering, who appreciated to the full the accurate and thoroughly scientific account of the modern gas engine and its congeners which the lecturer provided. A very similar audience attended Mr. H. L. Webb's lectures on "Telephony." Mr. Webb described the instruments, apparatus, and plant required for a telephone system, and in his last lecture discussed such general questions as rates, tariff, demands of consumers, development in various countries, and long distance service rates.

Mr. Alan Cole, to whom the Society has indebted for many valuable lectures and papers on lace and needlework, gave two very attractive lectures on "Some Aspects of Ancient and Modern Embroidery."

The last course of the Session was delivered by Mr. H. W. Ravenshaw, and dealt very completely with "The Uses of Electricity in Mines," a development which, in the opinion of many competent to judge, is likely to revolutionise the practice of one of our greatest industries.

VII.—Juvenile Lectures.

For the Juvenile lectures of the present Session the Society were indebted to their Treasurer, Mr. Carmichael Thomas, who utilised the experience he has gained by his long connection with *The Graphic* and *The Daily Graphic*, in the preparation of two lectures on "The Production of an Illustrated Newspaper." Dividing his subject into two, Mr. Thomas devoted his first lecture to the production of the material of a newspaper—news and illustrations; while his second lecture described the general production of a modern illustrated newspaper of the very highest class.

VIII.—Albert Medal.

The Council have awarded the Albert Medal for the present year, with the approval of His Royal Highness the President, to the Right Hon. Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S. "In recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses, and the development of apparatus for sound signalling at sea."

The Council have been glad to recognise once more the importance of pure scientific research in its effect upon industrial development. For many years past Lord Rayleigh has devoted his life to long-continued and patient research into the various branches of physical science. There can be hardly any branch of physics to which Lord Rayleigh has not contributed valuable knowledge. The important work which has been accomplished by various Committees, National and International, in formulating electrical standards and methods of electrical measurement has been to a very large extent founded upon Lord Rayleigh's researches. His investigations into optical science have had a marked influence in the construction of recent lenses, photographic and telescopic. He was the first to calculate the extent to which the definition of a spectroscope depends upon the actual thickness of the prisms, and this was applied later to the defining power of lenses; and while the improvement in modern lenses is largely due to the work of others than Lord Rayleigh, especially to those who have provided the lens-maker with glasses of high refractory powers, it is certain that the form which all photographic lenses now possess has been affected by his researches. Lord Rayleigh has been for some years past the Scientific Adviser of the Trinity House, a post in which he succeeded the late Professor Tyndall, and this led him to devote his scientific knowledge to practical investigations of his own, and he was thereby enabled to introduce several important improvements in the construction of apparatus for sound-signalling at sea. He is also Chief Gas Examiner in the metropolis, in which position his scientific training has proved of the utmost value.

His scientific work is of course outside the purview of the Society; but as evidence of his patient labours it may be worth mentioning that from the year 1869 until the present date he has written and published more than 270 papers, no less indeed than nearly eight for every year.

IX.—Medals.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1904-5:—

At the Ordinary Meetings:—

To Mr. Arthur Lee, J.P., for his paper on "The British Canals Problem."

To Mr. CHARLES DENTON ABEL, for his paper on "The Patent Laws."

To CAPTAIN LIONEL JAMES, for his paper on "Wireless Telegraphy and War Correspondence."

To the HON. ROBERT P. PORTER, for his paper on "London Electric Railways."

To Mr. R. CHILD BAYLEY, for his paper on "Time Development in Photography, and Mechanical Methods of Carrying it Out."

To BARON KENCHO SUYEMATSU, B.A., LL.M, for his paper on "Ethics of Japan."

To Dr. E. H. HANKIN, for his paper on "Methods of Design in Mohammedan Art."

To the RIGHT HON. SIR HERBERT MAXWELL, Bart., M.P., for his paper on "British Woodlands."

To Mr. GEORGE TORRANCE MILNE, F.R.G.S., for his paper on "The Industrial Resources of the State of Matto Grosso, Brazil."

To VISCOUNT MOUNTMORRES, for his paper on "The Native Races of the Unknown Heart of Central Africa."

In the Indian Section :—

To Mr. T. C. HODSON (late I.C.S.), for his paper on "Manipur and its Tribes."

To SIR J. GEORGE SCOTT, K.C.I.E. ("Shway Yoe"), Superintendent and Political Officer, Southern Shan States, for his paper on "The Prospects of the Shan States."

To Dr. CHARLES CREIGHTON, M.D., for his paper on "Plague in India."

In the Colonial Section :—

To Mr. BYRON BRENAN, C.M.G., for his paper on "British Commercial Prospects in the Far East."

To Mr. C. F. JUST, Canadian Government Service in London, for his paper on "The Manufactures of Greater Britain.—I. Canada."

To the HON. WALTER HARTWELL JAMES, K.C., Agent-General for and late Premier of Western Australia, for his paper on "The Manufactures of Greater Britain.—II. Australasia."

In the Applied Art Section :—

To Mr. THOMAS GRAHAM JACKSON, R.A., for his paper on "Street Architecture."

To Mr. F. BLIGH BOND, F.R.I.B.A., for his paper on "West Country Screens and Rood Lofts."

Two years ago it was decided that no medal should be awarded to readers of papers who had previously received medals from the Society. Acting on this rule the Council were precluded from considering the following papers :—At the Ordinary Meetings, the paper by Sir Charles Malcolm Kennedy, K.C.M.G., C.B., on "The Present Aspect of the Fiscal Question." In the Indian Section the paper by Mr. Henry John Tozer, M.A., on "The Manufactures of Greater Britain.—III. India," and that by Sir Charles Elliott, K.C.S.I., on "The Indian Census of 1901." In the Applied Art Section the paper by Mr. J. Starkie Gardner, on "The Monumental Treatment of Bronze." All these papers the Council consider to be of considerable merit and well worthy the distinction of a medal.

The thanks of the Council were also voted to Sir William Preece for his paper on "The Navigation of the Nile," the Council always feeling themselves debarred from awarding medals for papers read by members of their own body.

X.—OWEN JONES PRIZES.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Board of Education.

Six prizes were awarded this Session, each prize consisting, in accordance with the regulations laid down for the administration of the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates has already appeared in the *Journal*.*

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

XI.—NORTH LONDON EXHIBITION TRUST.

In 1865 the Committee of the North London Working Classes and Industrial Exhibition (1864) presented to the Society of Arts a sum of £157, the balance of the surplus from that exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art

* See *Journal*, vol. lii, p. 809, 23 September, 1904.

Workmanship Competitions were discontinued after 1870, and it has since been rather difficult to know how the funds arising from the Trust could be disposed of in a manner which might accord with the intention of the donors. In 1884 the Society awarded certain prizes in connection with the Inventions Exhibition, and among these was one (a gold medal or £20) offered under the Trust in question for the best set of specimens illustrating the handicraft teaching in any school. In 1896 an amount of £22 odd was awarded in prizes at the East London Exhibition, held in that year. There was in 1902 a small accumulation of the interest on the invested capital, and the Council decided that a very proper way of disposing of the available amount would be to offer it in art workmanship prizes for students connected with that part of the metropolis where the North London Exhibition was held. They, therefore, offered prizes for Art Workmanship amounting to Fourteen Guineas (a First Prize of £7 7s., a Second of £4 4s., and a Third of £3 3s.), to students in the Art classes of the Northampton Institute, Clerkenwell.

The prizes were duly awarded in November, 1903, and as the result of the competition appeared satisfactory, the offer was renewed for the following year, with the result that three prizes as before were awarded to successful students in the Artistic Crafts Department of the Institute.*

XII.—Prize for a Dust-Arresting Respirator.

It was announced in the last Annual Report that the Council were prepared to award under the terms of the Benjamin Shaw Trust a Prize of a Gold Medal, or Twenty Pounds, for the best Dust-Arresting Respirator for use in dusty processes, and in dangerous trades, and it was stated that the Committee appointed to consider the apparatus sent in had had before them inventions from 60 different inventors, of which 27 came from the United Kingdom, and 33 from other countries, viz., United States of America (9), Germany (6), Austria (6), France (3), India (2), Italy (2), Norway (2), Holland (1), Canada (1), Tasmania (1).

The final report of the Committee was received by the Council in May last, and was published in the *Journal* of June 9th. The report, while appreciating much of the apparatus which had been submitted to the Committee, found that none of them were sufficiently effective, or sufficiently original, to justify the award of the prize. The Committee stated that they had evidence before them showing that many of the apparatus submitted had been of great practical service, and they added that they recognised the efficiency of masks, even of quite a simple character, in protecting workpeople to a certain extent from various dusts. What, however, was wanted was something decidedly superior to any of the well-known masks now in use. It was hoped that the offer of a prize might produce such an apparatus, but this it has failed to accomplish. They continued, however, to recommend the problem to inventors, and they gave some notes on the apparatus which they had investigated, which they hoped might prove useful both to the inventors referred to, and to others who are endeavouring to solve a very difficult but important problem. While it appears to be rather too sanguine to hope that any device will be produced which can be satisfactorily and easily worn by a man doing hard physical work, there is no reason why a mask should not be made which would be effective in keeping out dangerous dust, without being so extremely inconvenient in use as quite to deter workpeople from its use. However efficient a respirator may be, it must to a certain extent impede breathing and must be more or less warm. The problem is to produce a piece of apparatus with a maximum amount of protection, and with a minimum amount of inconvenience.

In accepting the report of the Committee, the Council desire to express their disappointment that they were not able to find anything deserving the award, and to say that they will be always ready to renew the offer, if there seems any probability of such an offer producing any fairly satisfactory result.

The Council also desire to record their appreciation of the trouble taken by Mr. H. H. Cunynghame on behalf of the Committee, of which he acted as Chairman.

XIII.—Prizes for Drawing.

Since 1889, the Council have annually placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and these medals were awarded for drawings sent

* The following are the names of the successful students:—1903: First Prize, A. J. Downey; Second, S. F. Briault; Third, F. C. Latter. 1904: First Prize, E. A. Halfull; Second, L. E. Stanton; Third, F. Cockren.

in by students to the exhibition held by the Drawing Society in April last.

XIV.—EXAMINATIONS.

The great increase in the number of candidates at the Society's examinations has rendered it impossible to bring the returns to such a state as to enable the usual detailed review of them to appear in the present report. It is, therefore, only possible to give here a general summary of the work which has been done, and to leave the publication of details until a little later. The Council, however, are able to state that the alterations which were made this year in the examination system have been thoroughly successful, and appear to have met with the approval and appreciation of all concerned. The members will remember that instead of the old system of two grades—a general and an elementary—there are now three Stages—(1) Elementary, (2) Intermediate, (3) Advanced, the alteration having been made in consequence of the suggestions which have for some years past been made to the Council that it was desirable to establish a rather higher grade of examination, which might be taken by more advanced students than those generally entering for the Society's examinations. The Elementary Stage is the same in every respect as the Elementary Grade, which was first established in 1901. There has really been no change in it, except in its title. The old Grade II. was divided into two parts—Intermediate and Advanced. Candidates who had not previously passed in the Society's examinations, were recommended to enter in the first instance for the Intermediate Stage, while candidates who had already passed a Second or Third-class of Grade II., and had made progress, were expected to be able to take the Advanced Stage.

As a result, 8,427 papers were worked in the Elementary Stage, 10,534 in the Intermediate, and 4,842 in the Advanced. The total of all these, 23,803, is a very large increase on the total numbers for 1904, which in itself was higher than any previous year. But, except as regards the Elementary Stage, a detailed comparison of the results is precluded by the alteration in the system. The percentage of failures in the Advanced Stage is about a third, which may be taken as showing that on the whole not a very large proportion of insufficiently prepared students entered for this stage, and this is satisfactory. In the Intermediate Stage the percentage of failures is a little less (about 32 per cent.). It is satisfactory to note that of the subjects added to the Advanced Stage a considerable number (208) entered for Accounting and Banking, and 169 for Commercial Law. The other new subject, Hindustani, only attracted two candidates in the Intermediate Stage and none in the Advanced. Japanese, which has been on the list for a good many years, has for the first time attracted a few candidates. It is to be hoped that they are the precursors of a larger number in future years. As soon as the results are known with sufficient accuracy a summary of them will be given in the *Journal*, with such remarks upon the different subjects as may seem desirable.

XV.—VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

These examinations, which were established in 1902, are, it is satisfactory to be able to remark, attracting an increasing number of candidates. Up to the present date 15 examinations have been held this year in London and in Manchester. Arrangements have also been made for holding examinations at several other centres.

At these examinations 386 candidates presented themselves, of whom 296 passed (48 with distinction) and 90 failed. The languages taken up were as last year, French, German, Spanish, and Portuguese. Italian has been added, but as yet no examination has been held in that language.

The results of previous years are as follows:—

Year.	Number Examined.	Passed.	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165

These examinations are held at any of the Society's centres where the necessary arrangements can be made. They are held at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and the examination is so arranged as to test efficiency in a colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners, receive a certificate of having passed with distinction.

The examiners are Mr. E. L. Naftel for French, Professor H. G. Atkins for German, Professor Ramirez for Spanish, and Mr. J. d'Oliveria e Silva for Portuguese.

* A Table giving details of the results was published in the *Journal*, of the 23rd June, vol. liii., p. 837.

XVI.—Practical Examinations in Music, 1904.

The practical examinations in Music were not concluded last year until too late a date for the results to be included in the Report of the Council.

The examination was conducted as usual by Mr. Ernest Walker, M.A., Mus.Doc.Oxon, and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 578 candidates entered, and of these 557 were examined, an increase of 71 as compared with last year. This is the greatest number of entries yet received for these Examinations, the previous highest being 566 in 1901. There were 407 passes and 150 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, and viola. 466 entered for the piano, 342 of whom passed; 68 entered for the violin, of whom 52 passed; 2 entered for the violoncello, both of whom passed; 20 entered for singing, of whom 10 passed; 1 entered and passed for the viola. No medals were awarded.

XVII.—Practical Examinations in Music, 1905.

The Practical Examinations for the present year have not yet been concluded. They commenced on Tuesday, June 20th. They will be finished about July 5th, after which a summary of the results will be given in the *Journal*. The work of the examination is being carried out by the same examiners as in the last five years. 437 candidates have entered for the present examinations, a decrease on last year of 139.

XVIII.—Leather for Book-binding.

The Council regret that they are not yet able to announce the publication of the revised edition of the Report of the Committee on Leather for Book-binding. Various circumstances have led to a rather unexpected delay in its completion. It is, however, now practically finished, and almost ready for publication. The final corrections of the text are in the printer's hands, the coloured illustrations—eleven in number—have all been printed, and there is nothing remaining which ought to cause any further delay. The coloured illustrations include a frontispiece showing the effect of decay in leather-bound books, which has been admirably reproduced from the actual books by Messrs. Sanger Shepherd and Co., eight plates showing the effect on leather, dyed with various materials, of light and other injurious agencies, and two illustrating the effect of sunlight on various dye stuffs when applied to leather. These last have been excellently reproduced from the originals by the colour-type process of Messrs. Carl Hentschel, Ltd. There are also a number of pictures in the text illustrating the method of binding recommended by the Committee, and others showing the effect of strain upon various leathers. Some specimens of dyed leathers will be mounted in the covers of the book.

XIX.—Exhibition of Photogravure.

In the year 1899, an exhibition of lithography was held at the Museum, now named the Victoria and Albert Museum, by the Science and Art Department, at the instance of the Council of the Society. This exhibition, intended in the first instance to commemorate the invention of lithography by Aloys Senefelder in 1798, was very complete, and proved extremely popular.

In the following year, 1900, the Council suggested to the Board of Education that an exhibition should be held to illustrate the progress which had been made during the past forty years in the typographical reproduction of drawings for book illustration; the proposal was adopted, and this exhibition, which was held in 1901, also proved attractive and instructive.

The success of these two exhibitions induced the Counnil of the Society to suggest, in 1902, that the series should be completed by the holding of an exhibition comprising the various methods of illustration which have not been dealt with in the previous exhibitions, viz., engraving, photogravure, and the various photographic processes other than those applicable to typographical work. In the opinion of the advisory committee, to which this proposal was referred, it was of too wide a scope for it to be adequately treated in a

single exhibition, and they therefore recommended the Board of Education to divide the proposal into two, to hold an exhibition of engraving and etching alone, and to defer to a later period the holding of an exhibition which might illustrate the various applications of photography other than typographical.

The Board adopted this modification of the original suggestion, and accordingly arranged in 1903 an Exhibition of Engraving and Etching, consisting of examples of copper and steel engraving, including line, mezzotint and stipple (plain and coloured), aquatint and etching.

In December, 1903, the Board of Education informed the Council that they proposed to hold another exhibition, to comprise the remainder of the scheme suggested by the Council to the Board in 1902, and that the exhibition would include photogravure and other photographic processes, including printing in colours.

This Exhibition was successfully opened in March last. It includes a Historical collection, illustrative of the progress of the Art, a collection of Foreign work, and one of British examples. The processes represented include Photo-engraving (under its various names—photo-mezzotint, papyro-type, photo-etching, heliogravure, autogravure, photogravure, &c.), Photo-lithography, Photo-zincography, Collotype, Woodbury-type, and Three-colour process work.

This series of four exhibitions, carried out with great completeness by the Board of Education, on the initiative of the Society, covers the whole range of Graphic Art as applied to reproduction. It has certainly proved extremely popular, and it has, the Council hope, also been sufficiently useful to students to justify the Board for its outlay, and for the great trouble that its officials have taken in so efficiently carrying into effect the suggestions laid before them.

XX.—Journal Indexes.

In 1902, the 50th volume of the *Journal* was completed. The indexes for the 10 yearly volumes—Nos. 41 to 50—were amalgamated, and issued last July as the fifth 10-Volume Index to the Society's *Journal*. Notice was duly given in the *Journal*, and a copy of the index was forwarded to all members who applied for one. The previous 10-volume index for volumes 31 to 40 of the *Journal* is in print, and can be supplied to any members who require it.

XXI.—The Portrait of Sir Frederick Bramwell.

In November last, Mr. H. Graham Harris, lately a Vice-President of the Society, and for many years the late Sir Frederick Bramwell's partner, presented to the Society a portrait of Sir Frederick, specially painted for the purpose by Mr. Seymour Lucas, R.A. The portrait was a posthumous one, and consequently could only be executed from such materials as could be supplied in the way of photographs, painted portraits, &c.; but nevertheless, it is in the opinion of all who have seen it, an excellent likeness as well as an admirable work of art. In accepting it on behalf of the Society, the Council passed a resolution thanking Mr. Harris and expressing their appreciation of Mr. Seymour Lucas's work. A photogravure of the picture was issued as a supplement to the *Journal* of the 20th January last.

XXII.—List of Members.

The number of life and subscribing members on the Society's books is 3,722, this includes a few Institutions in Union who subscribe from their own funds. The number of new members elected during the year was 442; the losses by death and resignation amounted to 326.

During the last thirty-five years the number of the Society's members has not varied within very wide limits. In 1870 there were a little over 3,200; this rose in 1875 to 3,800. The numbers fell to 3,300 in 1881, and rose again to 3,656 in 1885. By 1899 the numbers had fallen to 3,078, rising again in 1900 to 3,123. Since then there has been a continuous increase up to 3,722 at the present time. In 1850 the numbers were a little under 2,000. The increase in the twenty years succeeding 1850 was doubtless due principally to the great exhibitions of 1851 and 1862. The number of Institutions in Union was much larger before the Examinations were thrown open. There are now in all only 22 Institutions in Union with the Society. Thirty-five years ago there were about 150.

XXIII.—Honorary Royal Members.

Under the provision of the Bye-laws, which authorise the Council every year to elect a certain number of life members of the Society, the Council have this year elected His Majesty the King of Spain as an Honorary Royal Member of the Society. His Royal Highness the President was good enough to communi-

cate his election to His Majesty, and His Majesty has accepted the election.

XXIV.—New Council.

The Vice-Presidents retiring this year are the Lord Chief Justice, Sir George Birdwood, Sir Charles Fremantle, the Lord Chancellor, and Lord Rothschild. The Lord Chief Justice has been nominated by His Royal Highness the President for election as a Vice-President, so that the number of Vice-Presidents will be increased from 22 to 23. To fill the vacancies the Council propose Sir William Crookes, the eminent physicist, who received the Albert Medal of the Society in 1899, Dr. Francis Elgar, who has served since 1901 as a Member of the Council, the Earl of Onslow, Sir Owen Roberts, who has been the Society's Treasurer for the past four years, and Mr. W. T. Shaw, who was the author of the proposal that the Society of Arts and the London Institution should be amalgamated.

The Members of Council retiring are Dr. Elgar, who, as above stated, is proposed as a Vice-President, Mr. H. H. Cunynghame, Sir Gilbert Parker, and Viscount Ridley. In their places the Council recommend Mr. Michael Carteighe, Mr. W. C. Knight Clowes, Mr. Henry Graham Harris, and the Hon. Richard Clere Parsons. All these, except Mr. Clowes, have served on the Council before, and have given constant attention to its work. Mr. Clowes, who is the head of the eminent firm of printers bearing his name, is an old member of the Society, and his family have been connected with the Society for a great many years past.

In place of Sir Owen Roberts, who retires from the office of Treasurer, the Council recommended Sir George Birdwood, whose long and energetic work on behalf of the Society is well known to the members.

XXV.—Conversazione.

The Society's annual Conversazione will be held on Tuesday next, the 4th July, at the gardens of the Royal Botanic Society. This is the fifth year in succession for which the gardens have been placed at the disposition of the Society of Arts. In previous years the entertainment has been very successful, and the Council trust that the Conversazione next Tuesday may be attended by a large number of the members and their friends. The arrangements will be of the usual character.

XXVI.—Obituary.

Sir Erasmus Ommanney, who died in December last, at the great age of 90, had been a member of the Society of Arts for more than 40 years, and was a member of the Council from 1870 to 1887. He was the first Chairman of the African Section when it was founded in 1874, and was a frequent attendant at the Society's meetings, retaining his interest in the Society's work until within the last year. A still older member of the Society was Sir Lowthian Bell, who joined it in 1859. He served for some years on the Council, and in 1895 he received the Albert Medal. Major-General Webber, who joined the Society in 1874, served on the Council with intervals from 1878 to 1884. He read several papers before the Society, and took an active part in the work of some of its committees. Sir John Simon became a member in 1876, and held the office of Vice-President in 1877-1878. Dr. Vivian Poore gave the Society a valuable course of Cantor Lectures on "Climate in its Relation to Health" in 1885. Mr. G. J. Morrison read an interesting paper on Maps and Charts in 1903, and for it he received the Society's Silver Medal. Dr. Isaac Roberts, the distinguished astronomer, had been a member of the Society of Arts since 1874, but never took any active part in its work. Another distinguished astronomer, Mr. Frank McLean, had been a member of the Society since 1861. Mr. Frederick Elkington, who had been a member since 1859, was closely connected with the early development of electro-plating, and the development of the firm bearing his name was largely due to him. Mr. Van Oven, who devoted himself to the improvement of the condition of the deaf and dumb, was a member of the Society of Arts since 1867, and an occasional contributor to its *Journal*. Mr. William Paul, the well-known horticulturist, who joined the Society in 1880, read a paper in 1889 on "Fruit Culture in England."

Among other members of the Society, of whom obituary notices will be found in the columns of the *Journal*, may be mentioned Colonel Sebastian Smith, Sir John Cutbbertson, Sir George Cotton, Sir David Tennant, General Cooke, and Sir John Barrant.

XXVII.—Finance.

The annual statement of receipts and expenditure was published—in accordance with the usual practice—in the *Journal* last week. It shows the revenue and expenditure for the financial year ending May 31st last, the Assets and Liabilities of the Society, its Investments and the Trusts standing in its name.

Among the receipts of the year is included a legacy of £250 left to the Society under the will of the late Mrs. Begley. Mrs. Begley, who died early this year, was elected a member of the Society in 1880. The Council have much pleasure in recording this appreciation of the Society's work on the part of one of its members.

The Statement shows that the finances of the Society are in a thoroughly sound condition, as has been the case for many years past. The invested property of the Society has shown a steady increase during the past thirty years, having grown from about £3,000 to over £21,000. This is exclusive of Trust Funds under the Society's control amounting to a little over £14.700.

The CHAIRMAN, in moving the adoption of the report, said he thought the members would feel satisfied with the work which had been done during the past year. The papers had been exceptionally good, and the finances of the Society were all that could be desired. Some of the papers he thought would prove to be historical and of lasting value. He felt sure the Society would approve of the action of the Council in awarding this year's Albert Medal to Lord Rayleigh, whose patient investigations into theoretical science had had a marked influence on applied science. Referring to the report of the Committee on Dust-Arresting Respirators, he regretted that the Committee had not been able to award the prize offered, but he thought they would have to wait a little time yet until something was produced which would solve the problem. The continued increase in the examinations he considered was becoming a question of very serious importance to the Society. The number of candidates had increased more than he anticipated; but he thought a proportion of the increase this year was due to the additional Stage which had been instituted, and that the rate of increase next year would be more normal than it has been in the present year. He referred to the Exhibition of Photogravure which has been held this year by the Board of Education at the Victoria and Albert Museum, and said it had been a great pleasure to him to act as Chairman of the Committee for the Exhibition. The Exhibition had shown the great progress which had been made in this country, particularly in colour photography and process work, although, speaking from a practical point of view, he thought there was a great deal of room for improvement in the composition of the colours used. There was a great lack of precision in the colours, and the colours which would be most efficient in use had proved not to be permanent. The question of the fading of colours, particularly dye-stuffs, required very careful investigation, and he hoped that chemists would take the matter up, and supply the manufacturers with colours which were tolerably permanent. With regard to the proposed amalgamation of the Society of Arts and the London Institution, he felt sure the members would be sorry that the negotiations had been brought to a close in the way they had. The Council had hoped that the matter would have gone through without any friction, as the benefits which would have accrued to the members of the Society would have equally accrued to the proprietors of the London Institution. He thought it a great pity that two flourishing institutions were unable to find some means by which they could amalgamate, and so more than double their powers of usefulness.

Mr. ADOLPH ARONSON seconded the adoption of the report.

Mr. MARTIN WOOD supported the motion, and said he should like to acknowledge the value of the report, and the success of the Society's operations during the year. At the same time he was sorry to see that the effort to enlarge the operations of the Society had been unsuccessful, although he quite appreciated the stand the Council had taken in the matter. He hoped the older and more wealthy members of the Society would bear the matter in mind, and that means would be forthcoming for providing the Society with a suitable building. The Society, he said, was an Institution of very high value, higher in proportion to the demands upon it to carry on its work. It was true that there were many competing Institutions, which took up special branches of science; but the members would see that the Society still held its place with the rest of them, and he hoped there was some prospect of the Society finding a suitable site in the metropolis. He thought if the Council would adopt his suggestion of a sliding scale of payments for life composition, it would tend to increase the number of members, as a certain number of the senior members who now drop off every year would thereby be retained. It was very satisfactory to the members to learn of the continued increase in the examinations. He had always felt that the examination work kept the Society in touch with the kingdom at large, and anything that could be done to strengthen that feeling should in his opinion be kept up. Referring to the paper by Mr. Arthur Lee on "The British Canals Problem," he said he wished the Council, in view of the steps which the Society took in 1888, could have seen their way to have taken some practical action in this matter. He also drew attention to the hour of the Annual General Meeting, and expressed the opinion that if it could be held in the evening it would be a good deal better attended.

Mr. JOHN HUME referred to the remarks of Mr. Martin Wood as to increasing the number of members, and suggested that each member of the Society should endeavour to get a friend to join. He said

he had tried the plan himself, and had found it comparatively easy. He thought if the members would bear the matter in mind, and speak to their friends about it, they would be astonished at the number of people who were quite willing to join the Society.

The adoption of the report was then agreed to.

The CHAIRMAN moved a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr. Henry B. Wheatley (the Assistant Secretary), and the other officers of the Society, which was seconded by SIR OWEN ROBERTS, and carried unanimously.

The SECRETARY returned thanks for this expression of confidence in himself and in the other officers of the Society.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Connaught and Strathearn, K.G.	*Francis Elgar, LL.D., F.R.S.*
Duke of Abercorn, K.G., C.B.	Robert Kaye Gray
Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.	Sir Charles Augustus Hartley, K.C.M.G.
The Lord Chief Justice, G.C.M.G.	Lord Kelvin, O.M., G.C.V.O., D.C.L., LL.D., F.R.S.
Sir James Blyth, Bart.	Sir William Lee-Warner, K.C.S.I.
Major-Gen. Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.	*Rt. Hon. the Earl of Onslow, G.C.M.G.*
Sir William Crookes, D.Sc., F.R.S.	Sir William Henry Preece, K.C.B., F.R.S.
Lord Curzon of Kedleston, G.M.S.I., G.M.I.E.	Sir Walter S. Prideaux
Lewis Foreman Day, F.S.A.	*Sir Owen Roberts, M.A., D.C.L., F.S.A.*
Sir James Dewar, M.A., LL.D., D.Sc., F.R.S.	Sir Marcus Samuel, Bart.
	William Thomas Shaw
	Alexander Siemens
	Sir John Wolfe-Barry, K.C.B., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.	William Bousfield, M.A., LL.D.
Sir Mancherjee Bhownaggree, K.C.I.E., M.P.	*Michael Carteighe*
Henry Graham Harris	*William Charles Knight Clowes, M.A.*
Col. H. C. L. Holden, R.A., F.R.S.	*Hon. Richard Clere Parsons, M.A.*
Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B.	Sir Westby B. Perceval, K.C.M.G.
	Dr. Boverton Redwood, F.R.S.E.
	Prof. John Millar Thomson, LL.D., F.R.S.

TREASURERS.

Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.	Carmichael Thomas

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, a vote of thanks to the Scrutineers was carried unanimously.

Sir THOMAS HOLDICH, K.C.M.G., K.C.I.E., C.B., proposed a vote of thanks to the Chairman for his services in presiding at the meeting, and also as Chairman of the Council during the past two years.

The motion was seconded by Mr. ROBERT KAYE GRAY, and carried unanimously.

The CHAIRMAN acknowledged the vote of thanks.

The meeting then adjourned.

INDUSTRIAL REVIEW OF NEW ZEALAND.

Government Blue-books and statistical returns generally may be said to develop their highest usefulness when they portray the subject of which they treat from the greatest possible number of aspects. One particular return in the latest statistics for New Zealand (for 1903)* is of great interest as, in addition to dealing with external trade, it gives the number of manufactories, works, number of hands engaged, value of manufactures produced, as well as the approximate value of land, buildings, machinery, and plant. The following are some brief abstracts relating to the condition of the more important local industries.

Preparation of Animal Food.—Among the various sub-headings that of meat freezing and preserving is of chief importance, some 2,221 hands (male and female) finding employment in 34 factories, and receiving in wages, in 1900, the sum of £199,725. The total value of the capital invested amounted to £893,720, while the value of manufactured produce

* Two vols. Printed by John Mackay, Government printer, Wellington.

was no less than £3,720,745. In 1895, the value of the produce only amounted to £1,652,275; while the value of machinery and plant and sites stood at £711,051, and wages paid at £180,775. That is to say, while the value of the capital employed rose by 25 per cent., the amount paid in wages rose by 20 per cent., and the value of the produce by 125 per cent. Butter and cheese factories rank second in importance under this heading, giving occupation to 1,188 hands at 247 factories, who received in wages £96,433. The total value of invested land, buildings, and machinery stood at £388,750. The value of the output is estimated at £1,535,150. Here, again, there have been tremendous advances during five years, the output being threefold, while the number employed has doubled, and the capital has increased by 60 per cent. Under this heading are several minor industries, such as fish, bacon, and ham curing, rabbit packing, and making of condensed milk.

Passing over the preparation of vegetable food, drinks, narcotics and stimulants, we come to industries involving a greater amount of manual and mechanical labour, such as wood working occupations.

Saw-mills, Sash and Door Factories. — These number 334 and employ 6,812 hands, who receive in wages £513,888. The cost of manufacture is a dominant feature with regard to output in work of this character. It is, therefore, not surprising to find that the value of the manufactured produce amounts to £1,268,689, or roughly 2½ times the wages paid, as against 20 times the value of the wages paid in the meat freezing and preserving works. The capital invested in these factories amounts to £703,620. Mechanical power is largely employed, no less than 8,744 horse-power being installed. As compared with the state of affairs in 1895 the number of hands employed have increased by 70 per cent., the value of the manufactured output by 33 per cent., and the capital by 20 per cent.

Paper-making is in an elementary stage, only three mills being in operation, employing 98 hands. Save that an aggregate of 705 horse-power is installed, other particulars such as total wages paid, value of output, etc., are suppressed in order that individual works may not be identified.

Gas and Electricity Supply Works.—Gasworks are erected at 30 places, employing 572 hands. The wages paid amount to £70,573, and the value of the output to £290,567. In numbers these works have only increased by three in five years; during this period six electric lighting works have been established, employing a small staff of 52 hands. The value of land, buildings, plant and machinery used for gasworks amounts to £971,559, and for electrical works to £64,156.

Iron and Brass Foundries, Boiler-making Machinists, &c., are doubtless well occupied in helping to meet the requirements of other industries. There are 35 factories in this class, employing 1,955 hands. The wages paid amount to £162,647. The value of plant, buildings, and machinery stood at £211,282, and the value of the manufactured produce stood at £508,906.

Engineering Works are separately defined for the first time in 1900. The distinction between a machinist's or a boiler-maker's and an engineer's work is one which cannot be readily drawn at this distance. In these 1,442 hands receive as remuneration £127,635. The value of finished articles produced amounts to £361,958. In the 1895 return this and the previously mentioned industry are lumped together, and it is therefore difficult to reckon the advance with the clearness desirable. The combined output has increased nearly three-fold, and the combined number of *employés* has doubled.

Agricultural Implements.—The making of these goods, an industry largely of an engineering nature, employs 586 hands, who earned in 1900 £53,941. These turned out goods to a total value (including repairs) of £138,094. Among the articles manufactured locally were 869 ploughs, 864 harrows, 242 rollers, 75 windmills, 89 wool presses, and numerous other goods.

Textile Industries.—These are at present very much in their infancy. There are 10 woollen mills—industries inevitably tend towards the source of one or other of their raw materials—employing a total of 1,693 hands, of whom 769 are male and 924 are female. The wages paid amount to £112,001, while the value of the output was £359,382. The total value of lands, buildings, machinery and plant was £277,422. The output in 1900 consisted mainly of 1,445,867 yards of tweed, 1,191,234 yards of flannel, 49,523 pairs of blankets, in addition to rugs, shawls, hosiery and yarn.

Clothing factories give employment to about 9,000 hands—they are too nmerous to mention under their separate headings. No cotton mills exist, but flax is dressed at 101 factories; 1,698 hands (all males) being employed. The total value of the output was £203,492 in 1900, being 6½ times the value in 1895.

Summary of Employment in Manufacturing Industries.—In all 46,847 persons, 36,292 being males and 10,555 being females, are employed in preparing food, clothing, or appliances for the use of the community and for export purposes generally. These earn in wages £3,302,647. The total value of the raw material on which they operate was valued at £7,749,770, and the value of all manufacturing produce (including repairs) stands at £17,853,133. Of the capital invested, £1,980,428 would be represented by the value of land occupied, £2,575,629 by buildings, and £3,852,457 by machinery and plant. This makes a gross total of £8,408,564. Reckoned on the mean population in 1900 of 763,594 persons, this would afford an average consumption in manufacturing industries of goods valued at £10 2s. 10d. per head of population, and an output of manufactured produce of £23 7s. 7d. per head of population.

The wealth of New Zealand is by no means expressed by the above figures. While manufactures are growing in importance, this growth has been occa

sioned by such matters as agricultural and metallurgical developments, which have also occasioned growing imports of various kinds. Before considering external trade, the indigenous industries call for consideration. The population being largely engaged in pastoral and agricultural pursuits, farm stock generally is increasing. The number of horses amounts to 298,714, the number of cattle to 1,593,547, and the number of sheep to 18,954,553. Pigs amounted to 226,591. The only decline is in regard to sheep, which fell from 20,342,277 in April, 1902, to the already quoted figure of 18,954,553 by April, 1903. A somewhat similar decline took place between April, 1895, and April, 1896. There were in 1903, 2,751 owners of flocks of sheep. Of these 2,081 owned flocks from 1,000 to 2,500, and 670 owned flocks of from 2,500 to 5,000.

Grain Crops.—The acreage of wheat under cultivation in 1903-1904 amounted to 230,436 acres, which yielded an average of 34·26 bushels per acre. Oats were cultivated upon 409,390 acres, yielding 38·57 bushels per acre. Barley, rye, and maize were cultivated to a smaller degree, the yields being 33·46; 17·00 and 47·53 bushels per acre. Of root crops, such as sown grass, 4,607,165 acres had been previously ploughed, and 7,342,006 acres had not been ploughed. Thus 5·22 per cent. of the total acreage is devoted to grain crops, 5·84 per cent. to green and other crops, and 88·49 per cent. to artificial pasturages, sown grasses and land in hay.

Gold Production.—Since 1857 the colony has produced 16,105,821 ounces of gold, valued at £63,149,147. The production reached its high-water mark in 1866, when the value of the production amounted to £2,844,517. The value fell year by year to £2,157,585 in 1870, rose to £2,787,520 in the following year, declining until 1890, when the value of the output was only £773 438. The production is now increasing and reached 533,314 ounces, valued at £2,037,831 in 1903. The number of hands employed amounted to 10,210 in 1903, of whom 477 were Chinese.

Gold mining operations are divided under three heads, (*a*) gold quartz mines, which in 1901 employed 4.333 males, who earned £382,658, the approximate value of machinery and plant being £735.927; (*b*) hydraulic gold mining, employing 962 males, paying them £76,008 for labour; and (*c*) gold dredging, employing 965 males, who earned £78,238; the value of plant and machinery being estimated at £690,430. It appears that the total revenue yielded to the Colonial Government amounted to £29,922.

Other Mineral Exports. — The value of other mineral exports is put at £858,874 for 1903. This included 911,914 ounces of silver (value £91,497); 152,332 tons of coal (value £128,927), add 9,357 tons of Kauri-gum (value £631,102). Except as regards coal, the whole of the mineral wealth appears to be exported. Out of 1,420,193 tons of coal raised, 152,332 tons only were exported, the value of the exported coal being estimated at £128,927, as against £633,931 retained for home consumption. The number of persons employed in coal mines amounted to 2,278, the large annual yield of 498 tons being secured per *employée*. The wages paid in 1901 amounted to £242,089, the number of hands then being 2,460. The approximate value of machinery and plant was then £372,093.

Export Trade as a Whole.—Excluding specie (and also the Maori population, for some reason which only the Government statisticians can explain) the exports per head of population amounted to £18 5s. 1d., or a total sum of £14,838,192. Of the export trade, goods and specie, to the value of £11,321,262, went to the United Kingdom, of £2,733,839 worth to the rest of the Empire (including Australia, £2,147,189), leaving £783,097 as the exports to the rest of the world. The United States purchased £669,649, and Germany only £17,584. Examining individual items of export, the United States purchased £362,890 worth of kauri gum, as against a British purchase of £238,083. Agricultural machinery to the value of £5,072 of local manufacture was exported, together with £6,602 worth of re-exported goods under this heading. Frozen meat went mainly to the United Kingdom under the following chief headings:—

Frozen beef........	£199,183
Frozen lamb	£1,120,716
Frozen mutton	£1,594,135

Tallow to the value of £458,851, and wool to the value of £3,998,569 were also exported to the United Kingdom.

Import Trade as a Whole.—Excluding specie the imports of New Zealand amounted to £12,075,959 in 1903. Reckoned per head of population, excluding Maoris, this amounted to £14 14s. 5d. The value of speccie imported was £712,716. Imports from the United Kingdom, including specie, amounted to £7,512,668, from Australia to £2,120,155, and from the rest of the British Empire to £1,015,319. The total imports from the British Empire, as a whole, thus amount to £10,648,142, leaving £2.140,533, or nearly 18 per cent. as coming from the rest of the world. Of this amount £1,441,358 is accounted for by the United States, and £274,297 by Germany. Considering individual items of import, chemical compounds come mainly direct from the United Kingdom, German competition being keenest in this direction. A few of the more important items are:—Acetic acid, ex United Kingdom, £1,710, ex Germany, £1,586; salicylic acid, ex United Kingdom, £82, ex Germany, £110; tartaric acid, ex United Kingdom, £3,044, ex Germany, £67; potash, ex United Kingdom, 1,087, ex Germany, 881; soda ash, ex United Kingdom, £4,760; caustic soda, ex United Kingdom, £8,102; unenumerated alkaline products, ex United Kingdom, £1,729, ex Germany, £1,140. Clothing to a value of £515,979 came from the Mother Country. Calico to the value £189,378 was imported, of which £183,296 came from the United

Kingdom, a somewhat similar proportion ruling with regard to other cotton goods.

Of iron and steel goods the United Kingdom exported the following quantities to New Zealand:—Bar, bolt, and rod iron, £107,485; pipes and fittings, £101,878; rails, £73,184; galvanized corrugated sheets, £200,657; as well as the bulk of each of the other imports under this head. As regards machinery the competition is much keener.

Agricultural Machinery.—Out of £108,310 value imported, £59,210 came from the United States, £19,753 from Canada, and £22,039 from Great Britain. Of £40,776 worth of dairy machinery, the United States sent £5,371, Sweden £15,358, the United Kingdom £4,655, and Australia £9,052. Electrical machinery came mainly direct from the United Kingdom, which supplied £47,472 out of a total of £77,413 entered subject to duty. The United States sent £9,190. Some £33,525 were entered as duty free, of which £32,566 came from the United Kingdom. Other varieties of machinery were imported from the United Kingdom to the following values: — Steam engines £11,551, gas engines £27,114, boilers £8,420, gas making machinery £23,631, mining machinery £34,210, portable and traction engines, £51,426; refrigerating, £5,436. In all these, as well as in regard to minor imports of machinery, the bulk comes direct from the United Kingdom.

Woollen Piece Goods are imported to the value of £400,206, of which £356,806 worth comes from the United Kingdom.

It is a reasonable assumption that a large proportion of goods imported into New Zealand, from Australia, come *viâ* Victoria and New South Wales. To allocate all of these as Australian in their origin, would be obviously unfair, as Sydney and Melbourne act as the *entrepôts* of a large distributing trade in British, German, and American wares. It is impossible also to assume that the imports coming from Australia in this process of distribution would bear the same definite proportionate origin as do the whole of the imports of these regions. It is probable that if the ultimate origin of all these goods were known, the predominance of the position occupied by the United Kingdom in the external trade of New Zealand might be either slightly increased or slightly decreased. In either case the change would not be a great one.

IRISH BANKING AND RAILWAY STATISTICS.

The Banking and Railway Statistics for Ireland just presented to Parliament indicate continuous and even rapid growth in material prosperity during recent years. An analysis of the tables given in the Report (Cd. 2519) gives the following results. In December, 1904, there was an increase of deposits and cash balances in the Irish Joint Stock Banks, as compared with the corresponding period of 1903, amounting to £716,000; there was an increase of £1,534,000 in deposits and cash balances in the Irish Joint Stock Banks in December, 1904, as compared with June of that year; there was an increase of £298,000 in the deposits of savings' banks in Ireland in December, 1904, as compared with the close of the year 1903, there having been an increase of £300,000 in the Post Office Savings' Banks, and a decrease of £2,000 in the amount in the Trustees Banks; there was an increase of £1,273,000 in the amount of Government Funds, Indian Stock, Guaranteed Land Stock, Guaranteed 2¾ per cent. Stock, and War Stock, on which dividends are payable at the Bank of Ireland, as compared with the amount at the close of the preceding year.

A diagram attached to the report shows the position and progress of the amounts of the deposits and cash balances in the Joint Stock Banks and the amounts of the deposits in Post Office and Trustee Banks during the forty-five years 1860–1904. The Trustees Savings' Banks show little change during that long period. In 1861 the deposits stood at £2,000,000, and they have never reached £2,500,000, the actual figures at the end of December last being £2,445,000, or £2,000 less than at the end of 1903. The Post Office Savings' Banks show a much more satisfactory growth. Established in 1862 the deposits did not exceed £2,000,000 until 1883. In 1884 there was a very slight increase but since then the growth has been much more rapid until at the end of last year they stood at £9,847,000. The deposits in Post Office and Trustee Savings' Banks nearly doubled in the decade ended December 31st, 1904.

The figures relating to Irish railway traffic are noteworthy. As given in the present report they cover the thirty years 1874–1903. In that period the total paid-up stock and share capital has only increased from £22,399,059 to £26,846,301, but the sums raised by Loans and Debenture Stock have risen from £7,443,304 to £11,116,951. The mileage has increased from 2,127 miles to 3,270, and whilst the number of passengers has increased from 16,535,578 in 1874, to 28,628,083 in 1903, there has been a large shrinkage in first and second class passenger traffic. In 1874, 1,914,181 passengers were conveyed first-class, in 1903, only 1,462,602; in 1874, 4,163,657 were conveyed second-class, in 1903 only 3,738,567. The receipts from first-class passengers fell from £273,777 in 1874 to £171,109 in 1903. On the other hand the receipts from third-class passengers rose in the same period from £584,251 to £1,170,125. The proportion per cent. of expenditure to total receipts continues very high, being no less than 61 per cent. in 1903. In 1901 it was the highest for the thirty years, namely, 63 per cent.

The report touches upon the growth of the co-operative credit associations. The organisation of co-operative credit associations in the rural districts of the South and West of Ireland was inaugurated

n 1894 by the establishment of a "bank" at Doneraile, Co. Cork. The success of this trial institution, which was founded on what is known as the Raiffeisen system, led to the creation of similar institutions in various parts of the country. The following statement shows the growth of co-operative credit associations in Ireland since 1895:—1895, 1; 1897, 3; 1900, 75; 1903, 201. The membership has grown from less than 50 in 1895 to 7,917 at the end of 1903. The total loans granted during the year 1903 amounted to £20,435 16s. 4d. The loan capital, which consists of (1) loans obtained from the Congested Districts Board, the Department of Agriculture and Technical Instruction, and the Joint Stock Banks, and (2) deposits made by members of the co-operative credit associations, amounted to £19,588, as compared with £13,956 in the previous year. The loans averaged very small sums, but the net loss on the whole of them was only £6 4s. There are no paid officials in these credit associations, all the services for management and control being given without reward. There can be no doubt that the associations are doing a good work in Ireland, as in Germany, Austria, Italy, and France. These credit associations deal only, and by their nature can only deal with a small part of the whole field of agricultural credit, but in Ireland it is a very important part.

AUSTRALIAN SILVER PRODUCTION.*

It is only within the last few years that Australia has become one of the leading silver-producing countries of the world, although the metal is to be found in all the States, either alone or in the form of sulphides, antimonial and arsenical ores, chloride, bromide iodides, and chloro-bromide of silver, and argentiferous lead ores, the latter constituting the largest deposits from which the metal is obtained. Less than twenty years ago the quantity of silver, silver-lead, and silver ore exported from Australia was trifling compared with the proportions assumed at the present time, the exports during 1903 comprising 1,033,920 ounces of silver contained in matte, 1,603,926 cwts. of silver ore, and 553,308 of silver bullion, the total being of the estimated value of £1,177,177. The whole of this was of Australian origin. In 1904 there was an increase of production in New South Wales, the exports from that State reaching the record value of £2,065,540. The two leading silver-producing States are New South Wales and Tasmania. The principal supply in the former is obtained from Broken Hill, which is also the centre of one of the largest pastoral districts in the Commonwealth. It is situated about 925 miles north-west of Sydney, near the South Australian border, the nearest port being Port Pirie, in the latter State, where smelting operations are conducted on a large scale. Broken Hill forms portion of the Barrier district, so called from a series of low hills known as the Barrier Range, and including Silverton, Thackaringa, and other argentiferous localities. The Barrier silver field extends over 2,500 square miles of country, and was discovered in 1883 by a boundary rider named Rasp. At that time hardly anything was known of the country, there being no roads and scarcely any population, but at the present time Broken Hill alone has a population of over 28,000. The leading mine, the Broken Hill Proprietary, is the most prolific silver mine in existence, the production from the commencement of mining operations in 1885 to the middle of 1904 being 7,134,526 tons of silver and silver-lead ores, from which were obtained 124,552,679 ounces of silver and 663,423 tons of lead, valued in the London market at £26,896,000. The lode is the largest yet discovered, varying from 10 feet to 200 feet in width, and traceable a distance of several miles, the country having been taken up all along the line in leases held by mining companies and syndicates. In Tasmania the principal silver fields are in the western and north-western districts, the largest output being from the Mount Lyell mine, where the metal is found in conjunction with copper. Silver is found in various parts of Queensland, mostly associated with other metals, the principal mine being at Texas, in the Stanthorpe district. There are no silver mines in Victoria or Western Australia, but this is more than compensated by their auriferous richness; the metal is, however, occasionally found associated with gold. In 1903 the value of the Victorian silver thus obtained was £2,280; that produced in Western Australia being valued at £19,153. Although the Barrier silver field approaches very closely to the South Australian border, it does not cross it, hence the silver production of that State in 1903 reached a value of only £2,071. The great difficulty hitherto experienced in the silver mining industry has been the want of some cheap and effectual method of treating refractory ores. Much has been done in this direction at Broken Hill, and practical men entertain an opinion that within the next few years the cost of extracting the silver and dealing with the other metallic contents of the ores will be reduced fully one-half if not more. The total value of the silver raised in the Commonwealth to the end of 1903 was £40,124,145, as follows:—New South Wales, £35,283,159; Tasmania, £2,872,276; Queensland, £923,725; Victoria, £864,276; South Australia, £140,441; and Western Australia, £40,425. There are rich silver deposits in the Northern Territory of South Australia, but up to the present none have been worked to any extent. In one locality extensive silver lodes have been discovered, carrying 100 ounces of silver and a large per-centage of lead to the ton. Lodes of silver-bearing ores have also been found near the Mary river, from 50 to 100 ounces per ton. Most of the lode silver comes from galena, which, as a rule, is very rich in the metal.

* Communicated by Mr. John Plummer, Sydney, New South Wales.

GERMAN MACHINE INDUSTRY.

In accordance with the general upward movement of other industrial branches at the close of the last century, the German machine industry has materially developed. During a comparatively short time many new works have been erected and old plants have been enlarged. In addition their capacity has been increased by the application of quick-turning tools, and through better working methods, so that their total capacity is estimated to have more than doubled since 1890. The home consumption is very far from being in a position to take up the entire German production. Moreover, the prevailing unfavourable economic condition is rendered more severe by the fact that the crisis, according to the United States Consular Agent at Gera, due to the introduction of large gas motors and steam turbines, has not yet fully subsided. As a consequence, many works are forced to resort to new branches and to continually expend large sums for trials and tests. Furthermore, it is stated that the new commercial treaties will prove a great drawback to the exportation of large German machines. Also fears are entertained that the strike of the miners in Westphalia will unfavourably influence the working people engaged in the machine industry, and render the relations between employers and *employés* more and more disagreeable. According to a report of the United German Engine Manufacturers, numbering about 160 of the most prominent makers, the value of the total exports of machines from Germany in 1904 amounted to about £12,900,000, which amount is expected, however, to experience a considerable reduction by the new commercial treaties. For this reason, a strong coalition of all machine manufacturers is suggested, with the object of effectually safeguarding the interests at stake, as is done now in the case of the coal and iron interests. To ensure success for every branch, the formation of groups with equal producing capacity is advised. Besides, special efforts are recommended towards attaining more advantageous commercial treaties with the United States, the United Kingdom, and Argentina. To show the disparity between the tariffs of the different nations, it is asserted that a steam engine of 3,000 horse power, and of a value of £11,500, is subject to a duty of £457 when introduced into Germany. When exported, however, to Austria, a duty is charged thereon of £1,900; to Russia, £5,500; to Italy, £1,250; and to Switzerland, £522.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in March and April last:—

New Charts.—No. 3479—Baltic sea; Gulf of Finland:—channels leading to Viborg. 73—Spain, north coast:—Port Pasages. 3485—Greece, west coast.:—Port Plateali (Platea). 1198—Sea of Marmara:—The Bosporus (plan:—The Golden Horn). 3488—Iceland, north coast; Eyia (öe) fiord. 3433—Newfoundland, Bay of Exploits; Sheet II. (Middle). 3434—Newfoundland, Bay of Exploits; Sheet III. (South). 707—Madagascar, north-west coast:—Ambavatobi bay. 3486—Cochin China:—River Matshé. 951—Japan; Nipon, south coast:—Osaki wan to Owashi wan; (plans:—Goba anchorage; Kinomoto road). 3469—Japan, inland sea:—Hiroshima wan; (plans:—Ono seto; Karoto koseto). 2511—Japan sea; Russian Tartary:—Strelok bay to Mosolova point; (plans:—Uspeniya bay; Olga bay; St. Valentine bay). 3481—New Zealand:—Awarua or Bluff harbour. 3490—New Zealand, west coast South island:—Buller bay and Westport harbour. 1300—Chile; plans on the coast of:—New plan; Horcon and Quintero bays. 3313—Alaska; Yakutat bay; plan added:—Controller bay. 3136—Alaska, anchorages in; plan added:—Shearwater bay. 1457—Alaska, anchorages in; plan added:—Nateekin bay. 949—Ports in the Philippine islands; new plan:—Port Galera and Varadero bay. 981—Caroline islands; Seniavina islands; new plans:—Port Metalanim; Port Lot.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

No. 1188—The World:—Coal and Telegraph chart. 1698—England, south coast:—Dover bay. 2006—Scotland, west coast:—River Clyde from Greenock to Dumbarton. 2690—France, west coast:—Brest roadstead. 1996—Adriatic sea:—Fiume, including port Martinscica. 445—Black sea:—Pyrgos or Burghaz bay. 2210—Black sea:—Plans in the Black sea. 234—Africa, north coast:—Port Said. 2282—Arctic ocean and Greenland sea. 2600—West Indies, Leeward islands:—San Domingo to Dominica. 3408—West Indies, Leeward islands:—Puerto Rico. 130—West Indies, Leeward islands:—Anguilla to Puerto Rico. 1938—South America, east coast:—River Uruguay. 1982A, 1982B—South America, east coast; Sheets I. and II.; Parana river. 631—Chile:—Smyth channel from south entrance to Fortune bay. 24—Chile:—Channels between gulf of Trinidad and gulf of Penas. 1289—South America, Chile:—Guaytecas islands to cape S Antonio. 1319—Chile:—Conception bay. 1300—Plans on the coast of Chile. 1082—United States, west coast:—harbours on the coast of California. 2431—Alaska:—Port Simpson to Cross sound. 1499—Alaska:—Cross sound to Kadiak island. 14—Red sea:—harbours and anchorages in the Red sea. 2578—Philippine islands:—Eastern part of the Sulu or Mindoro sea. 2723—China sea; Gulf of Siam; Sheet V.:—Bay island to Pulo Obi. 2725—China sea; Gulf of Siam:—Koh Tron, &c. 1261—China sea; Cochin China:—Saigon river to Kam ranh bay. 1008—Cochin China:—Kam ranh bay to Vung-Ro bay. 3010—Cochin China:—Fuyen and Ku Mong harbours. 264—Cochin China—Hué river entrance.

1767—China, east coast:—Amoy harbours. 1583—China, east coast:—Nimrod sound. 2416—Japan:—Liu Kiu islands. 358—Japan:—Western coasts of Kinsiu and Nipon. 3112—Japan:—Misumi ko Fukin. 1648—Japan:—Van Diemen strait to O Shima, &c. 2731—Australia, south coast:—Geelong harbour. 3436—New Zealand:—Plate island to cape Runaway.

These charts are issued by Mr. J. D. Potter, 145, Minories.

GENERAL NOTES.

JEWISH COLONIES IN PALESTINE.—In his report on the Trade and Commerce of Palestine for 1904 (No. 3410, Annual Series), Mr. Consul Dickson gives some interesting particulars respecting the Jewish colonies established in Palestine. Of these, three, namely, Mulebbis, Richon-le-Zion, and Ekron, were founded and supported by Baron Edmond de Rothschild; three, Katra, Kustinch, and Mozah, owe their origin to the Howawé-Zion Association; and the three remaining ones, Rehobot, Wady-Hanein, and Artuf, have been established and are maintained by private individuals. There are several additional Jewish colonies of importance which have been founded in Northern Palestine and Syria, and some of them have grown considerably of recent years, and may be said to be in a flourishing state. The colony of Mulebbis was founded as far back as 1879 by some Jews of Jerusalem and Jaffa, but the climate proved unhealthy, the colonists were inexperienced as farmers, their capital was too small, and they got into great straits. Baron Edmond de Rothschild then came to their assistance, and during the next twenty years he spent many millions of francs in assisting the colonists of Mulebbis, and Jewish settlers in other localities. After many vicissitudes Mulebbis is now a large and flourishing settlement. The planting of eucalyptus trees has improved the climate, and many orange gardens have been planted in consequence of the increasing demand for Jaffa oranges in the European markets. The colony numbers about 820 settlers, who own 3,000 acres of land. Richon-le-Zion is about eight miles east of Jaffa, and was founded in 1882. It has 700 inhabitants, owning 1,500 acres of land. The prosperity of the settlement depends in great measure upon the demand which its wines and brandies may find in the European markets and those of America. The wines are said to be of excellent quality, but until a short time ago the consumers were mainly members of the Jewish faith. The reputation of the wine, however, is now spreading, and the large stock of it in the transit cellars of Hamburg has proved advantageous, inasmuch as the wine has improved in a cooler temperature, and from Hamburg, as a depôt, the sale in Europe can be pushed. At Ekron the colonists first followed agriculture with good results, but being strict Jews, and refusing to sow every seventh year, in spite of permission granted by the Rabbis, the board of administration of Baron de Rothschild decided to curtail the growing of crops within certain limits, and to try the planting of fruit trees and orange groves instead. Apricots, almonds, and peaches, as well as oranges have been cultivated with success, but until now the return has been insufficient to render the colonists self-supporting. Altogether it may be said that the Jewish colonies in Palestine are now, for the most part, fairly prosperous, but even now some of them, as at Ekron, are not self-supporting.

THE GROWTH OF ROME.—In his report on the Trade of Central Italy for 1904, Mr. Consul Morgan gives some interesting figures bearing upon the growth of Rome since it became the Italian capital. In 1871, the number of its inhabitants was only 248,208, in 1904 they had more than doubled, being 503,857. The number of births in 1871 was 6,940, and of deaths, 9,073, and the respective numbers in 1904 were 12,187 and 9,957. So that whilst the births had almost doubled, the deaths had increased by no more than 10 per cent. The death-rate which in 1871 was no less than 41·8 per 1,000 inhabitants, had fallen in 1904 to 19·7. A firm of Belgian bankers have recently formed a company with the object of building an electric railway line between Rome and Civita Castellana. The capital of the company is £140,000. The distance between Rome and Civita Castellana by the existing railway line is about 50 miles, and the proposed new line, which follows a regular and direct tract, will shorten that distance by 15 miles.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JULY 3...Faraday Society (at the Institution of Electrical Engineers), 92, Victoria-street, S.W., at 8 p.m. 1. Mr. Sherard Cowper-Coles, "Some Notes on the Rapid Electro-deposition of Copper." 2. Prof. W. W. Haldane Gee, "The Use of Balanced Electrodes." 3. Messrs. H. D. Law and F. Mollwo Perkin, (a) "Electrolytic Oxidation of Hydrocarbons of the Benzene Series." Part I.—"Ethyl Benzene, Cumene and Cymene"; (b) "Electrolytic Analysis of Antimony." 4. Messrs. R. S. Hutton and J. R. Beard, "Notes on Heat Insulation, particularly with regard to Materials used in Furnace Construction."

TUESDAY, JULY 4...SOCIETY OF ARTS, Conversazione in the Gardens of the Royal Botanic Society, Regent's-park, N.W., 9 p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Prof. H. J. Webber, "The Progress of Horticulture in the United States."

WEDNESDAY, JULY 5...Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Charles Lynam, "A Short Note on Chepstow Parish Church."

THURSDAY, JULY 6...East India Assoc., Caxton hall, Westminster, S.W., 4 p.m. Sir David Barr, "Hyderabad—Past and Present."

FRIDAY, JULY 7...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m. Mr. Strang, "A Method of Portrait Drawing."

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NOTICES.

ALBERT MEDAL.

The Council of the Society attended at Marlborough House, on Wednesday, the 5th inst., when His Royal Highness the Prince of Wales, President of the Society, presented the Albert Medals for 1904 and for 1905.

The Medal for 1904 was awarded to Mr. Walter Crane, "in recognition of the services he has rendered to Art and Industry by awakening popular interest in Decorative Art and Craftsmanship, and by promoting the recognition of English Art in the forms most material to the commercial prosperity of the country."

The Medal for 1905 was awarded to the Right Hon. Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S., "in recognition of the influence which his researches, directed to the increase of scientific knowledge, have had upon industrial progress, by facilitating, amongst other scientific applications, the provision of accurate electrical standards, the production of improved lenses, and the development of apparatus for Sound signalling at sea."

The members of Council present were Sir William Abney, K.C.B., D.C.L., Sc.D., F.R.S. (Chairman), Sir Steuart Bayley, K.C.S.I., C.I.E., Sir George Birdwood, K.C.I.E., C.S.I., Sir James Blyth, Bart., Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Sir William Crookes, Sc.D., F.R.S., Dr. Francis Elgar, F.R.S., Mr. Robert Kaye Gray, Sir Charles Hartley, K.C.M.G., Col. Sir Thomas Holdich, R.E., K.C.M.G., K.C.I.E.. C.B., Sir William Lee Warner, K.C.S.I., Sir Gilbert Parker, D.C.L., M.P., Sir Westby Perceval, K.C.M.G., Sir William H. Preece, K.C.B., F.R.S., Sir Owen Roberts, D.C.L., Sir Marcus Samuel, Bart., Mr. Alexander Siemens, Sir Boverton Redwood, Mr. Carmichael Thomas, Sir John Wolfe-Barry, K.C.B., F.R.S., with Sir Henry Trueman Wood, M.A. (Secretary, and Mr. Henry B. Wheatley (Assistant Secretary).

CONVERSAZIONE.

The Society's Annual Conversazione was held in the gardens of the Royal Botanic Society, Inner Circle, Regent's-park, on Tuesday evening, 4th inst.

The reception was held by Sir WILLIAM ABNEY, K.C.B., D.C.L., F.R.S., Chairman, and the following Members of Council:—Sir Mancherjee Bhownaggree, K.C.I.E., M.P.; Sir William Bousfield, LL.D.; Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.; Dr. Francis Elgar, F.R.S.; Mr. Robert Kaye Gray; Mr. Henry Graham Harris; Sir Charles Hartley, K.C.M.G.; Colonel Sir Thomas Holdich, R.E., K.C.M.G., K C.I E., C.B.; Sir Boverton Redwood; Sir Owen Roberts, D.C.L.; Mr. Alexander Siemens; Mr. Carmichael Thomas; Professor J. M. Thomson, LL.D., F.R.S.

A Selection of Music was performed by the String Band of H.M. Royal Artillery (Conductor, Cavaliere L. Zaverthal, M.V.O.) in the Conservatory, and by the Band of H.M. Grenadier Guards (Mr. A. Williams, Mus. Bac., Oxon) in the Gardens.

Two performances of Selections from Pastoral Plays were given in the Gardens by Mr. Patrick Kirwan's Idyllic Players.

A Concert and Entertainment by members of Mr. Kirwan's Company of Idyllic Players, with Choruses by Children, was given in the Club House.

An Exhibition of Growing and Cut Roses and other Flowers was arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

An Exhibition of Economic Plants, &c., grown in the Gardens of the Royal Botanic Society, together with specimens from that Society's Museum, were on view in the Corridor.

The Tropical House, containing the giant water lily (Victoria Regia), &c., was open to visitors.

The number of visitors attending the Conversazione was 2,335.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

INTERNAL COMBUSTION ENGINES.

By Dugald Clerk, M.Inst.C.E.

Lecture I.—Delivered February 13th, 1905.

Syllabus.

Fundamental Principles. — Internal combustion engines essentially air engines — Thermodynamics air engines—Two types, constant volume and constant pressure — Theory of compression — Efficiencies without heat or other losses—Gaseous explosions—Measurement of temperature in gaseous explosions—Bunsen's method—Coal gas, petrol, cohol, and producer gas explosions — Data still uired.

An internal combustion engine is a heat engine in which the working fluid is atmospheric air, and the fuel is an inflammable gas or vapour. It differs from a hot air or steam engine in one important point, that is, the heat to supply the motive power is given directly to the working fluid by combustion within the motor cylinder.

It has long been recognised that the air engine presents many points of advantage over the steam-engine in enabling much higher efficiencies to be obtained than are possible with steam boilers and engines. Nearly all the great men who founded the science of thermodynamics, about the middle of last century, recognised this fact, and many attempts were made to realise the advantages of the air engine. Some were very bold and able, and, for the time, may be considered partially successful.

So long ago as 1854, the late Professor Rankine read a paper before the British Association "On the Means of Realising the Advantages of the Air Engine," in which he expressed his belief that such engines would be found to be the most economical means of developing motive power by the agency of heat. In this opinion he stood by no means alone. Engineers so able as Stirling, Ericsson, physicists so distinguished as the late Dr. Joule and Lord Kelvin, happily still with us, devoted much time and study to their theory and practice.

Many attempts were made, long before 1854, to carry such ideas into practice; and my friend, Mr. James Forrest, has recently presented me with prints of three papers read at the Institution of Civil Engineers in 1845, 1853, and 1855. The first paper is by James Stirling, the son of the original inventor, Dr. Stirling. It is upon "Stirling's Improved Air Engine." The second document, dated 1853, includes three papers—one by Charles Manby, another by James Leslie, and a third by William Siemens, so well known in connection with this and other subjects later on. The third document is entitled "On the Use of Heated Air as a Motive Power," by Benjamin Cheverton, dated 1855. This document also includes a paper by Sir George Cayley. The discussion on these papers includes many distinguished names, among them Armstrong, Rennie, Siemens, Bidder, Faraday, Brunel, Hawksley, Fitzroy, Braithwaite, and Robert Stephenson.

Even so long ago, then, as the middle of last century, it may be said that abundant engineering and scientific talent had been brought to bear upon this important question, and a general agreement of opinion, even then, existed, to the effect that air engines should be more economical of fuel than steam engines.

Notwithstanding all the efforts of these distinguished men, aided by a host of less able but equally enthusiastic inventors, the difficulties of the task proved too formidable, and it may be said that the hot air engine proper has made no real advance.

It was very early recognised that one leading difficulty was found in the very slow transfer of heat through metal to air. Ericsson and Sir George Cayley recognised this difficulty very early in the day, and they attempted to overcome it by what may be called internal combustion, that is, they heated their air by forcing the air through an enclosed furnace, and then passing it into the engine cylinder. These attempts, however, also failed, because of the heat loss in passing through valves, and the difficulty of keeping valves exposed to high temperatures sufficiently pressure tight.

The modern internal combustion engine differs from these crude attempts by invariably conducting the combustion within the cylinder, and burning only vapour or gaseous fuel. The method of heating by combustion or explosion at once disposes of all these troubles. It not only widens the limits of the temperatures at command almost indefinitely, but the causes of failure with the old air heating methods become the very cause of success with the new. The difficulty of heating even the greatest masses of air is quite abolished. The rapidly moving flash of chemical action makes it easy to heat any mass, however great, in a minute fraction of a second; and when once heated

the comparatively gradual convection makes the cooling a very slow matter. The conductivity of air for heat is but slight, and both losing and receiving heat from enclosing walls are carried on by a process of convection, so that the larger the mass of air which is used, the smaller is the relative cooling or heating surface. From this it follows that the larger the volume of air used, the more economical is the new method, and the more difficult is long as we keep in mind that corrections have to be made, in applying the ideas gained from air engine reasoning to practice, it will be better first to treat of our subject as if we were dealing with air only as the working fluid, and consider the air as heated by combustion without changing its chemical or physical properties. Therefore I will deal first with the thermodynamics of the internal combustion motor, considered as an air engine pure and

FIG. 1.

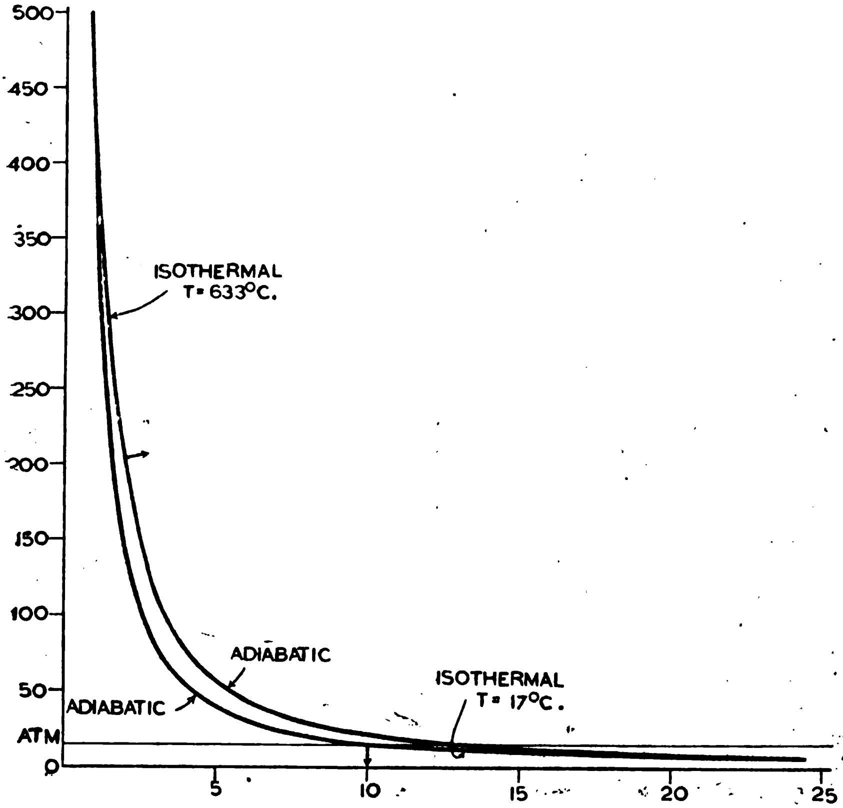


DIAGRAM FROM AIR ENGINE OPERATING ON CARNOT CYCLE.

Maximum pressure = 500 lbs. per sq. in.; mean pressure = 6 lbs. per sq. in.; maximum temperature = 633° C.; efficiency = ·64.

the old. The low conductivity for heat which was the cause of so much trouble in hot air engines becomes the unexpected cause of economy in the modern motors.

It is quite true that the internal combustion engine differs in many respects from an air engine pure and simple, yet it will be more convenient to consider these engines as simply air engines in the first instance, so as to avoid certain complexities of thought introduced by the chemical changes due to combustion. So simple. In all modern motors of this type, whether they be operated by coal gas, petrol, alcohol, or producer gas, one feature is invariably found. That feature is the compression of the working fluid before combustion. Although all engine builders use this compression, even now the true function of compression is not always clearly understood.

Over twenty years ago, a perusal of the engineering journals, and a consideration of some decisions in Patent actions in the

Law Courts, will show what ludicrously erroneous notions were held upon this subject. It was supposed that the advantage given by compression was due to the use of what was called stratification in the gas engine, and the supposed possibility of firing dilute combustible mixtures without shock. This fallacy was shared by quite a number of distinguished men, and the true theory of compression was enunciated for the first time in a paper read by me before the Institution of Civil Engineers in the year 1882. It was there pointed out that compression gave a cycle of operations having a distinct thermodynamic advantage, apart from all considerations of heat losses. It is often said that compression is only useful as a means of gaining a great expansion with a small cylinder volume, and this statement is no doubt partly true. It does not, however, express by any means the entire truth. There is much more in compression than this. Compression is advantageous not only because it allows of higher operative pressures for given temperatures and higher expansions, but also because compression forms an essential part of the operation of any ideally perfect heat engine.

It has long been recognised that an engine operating upon what is called the Carnot cycle gives the highest conversion of heat possible between the available temperature limits. The diagram, Fig. 1, shows what occurs in an engine operating in accordance therewith. In order to be explicit, I have calculated out this diagram for an engine operating with a maximum pressure of 500 lbs. per square inch absolute, using pure air as the working fluid. On the diagram you will observe two lines, one marked "isothermal," and the other marked "adiabatic." I need hardly state that an isothermal line in this connection is an expansion or compression line, where the temperature of the working fluid remains constant, and that an adiabatic line is a line of compression or expansion, where no heat is either added to or abstracted from the working fluid, where consequently temperature rises during compression, and falls during expansion. With an air engine operating in this manner the proportion of heat converted into work is very easily calculated. All the heat is added at the upper temperature, and all the heat discharged at the lower temperature, It can be readily shown that the efficiency is

$$\frac{T - T^1}{T}$$

T being the upper temperature, and T^1 the lower temperature. The proof of this statement is to be found in every engineering work dealing with thermodynamics. Such an engine converts all heat into work which can be converted. As you know, the second law of thermodynamics, on which the reasoning from

FIG. 2.

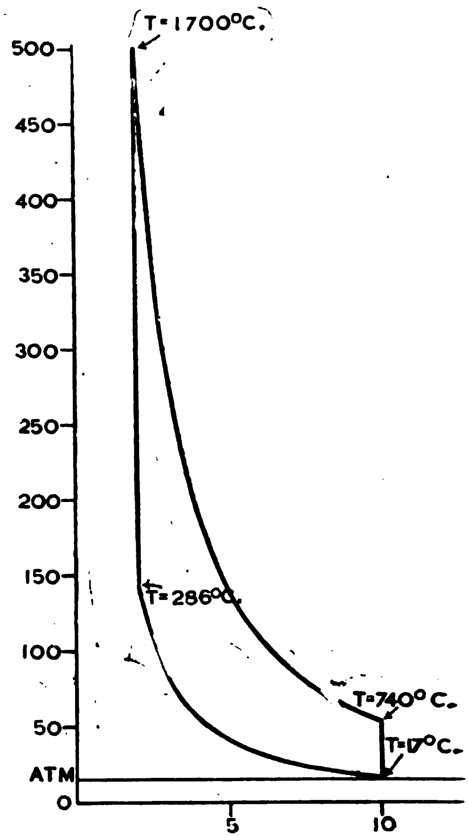


DIAGRAM FROM AIR ENGINE OPERATING ON OTTO CYCLE.

Maximum pressure = 500 lbs. per sq. in.; mean pressure = 105 lbs. per sq. in.; $\frac{1}{r} = \frac{1}{5}$; efficiency = ·48; maximum temperature = 1,700° C.; compression temperature = 286° C.; exhaust temperature = 740° C.; minimum temperature = 17° C.

the Carnot cycle is based, proves that only a certain proportion of the total heat given to any working fluid can be converted into work, and that proportion depends upon the difference between the higher and lower temperatures. Under the diagram, Fig. 1, I have marked the principal data, including the higher and lower temperatures, the maximum pressure, and the mean pressure. Also the

volume swept by the piston, taking the volume swept for adiabatic compression as unity. From these figures you will see that although the efficiency is the maximum possible within the temperature limits, the performance, that is, the actual amount of work obtained from the engine for a given size of cylinder, is exceedingly low.

Although the maximum pressure is 500 lbs. per square inch, the mean available pressure is only 6 lbs. per square inch for the particular case shown. The efficiency is high, ·64, but obviously an air engine following the Carnot cycle would be useless for all practical purposes, as the mean pressure is so low in proportion to maximum pressure.

In a recent discussion by Professor Callender, he calls the Carnot cycle a constant temperature cycle. At Fig. 2, there is shown a diagram having a similar maximum pressure. This diagram represents that which would be given by an air engine following closely all the conditions of the best known modern types of internal combustion engine, viz., the Otto, or four stroke cycle. In this engine, there is compression of air from maximum to minimum volume without gain or loss of heat; addition of heat at minimum volume, rising from temperature of compression to maximum temperature; expansion without gain or loss of heat to maximum volume; and discharge of heat at maximum volume to original temperature. For the purpose of reasoning clearly, I assume that all heat additions and abstractions are made at constant volume in any manner you may conceive possible. It is better to think of the same mass of air always in use, alternately heated and cooled at constant volume, and alternately compressed and expanded adiabatically. I should say that in both adiabatic compression and expansion, I have assumed the ratio between specific heat at constant volume and constant pressure to be 1·408, so that the equation of each curve is $PV^{1\cdot 408}$ = constant. I also assume the specific heat of air to be constant throughout the whole temperature range, and the addition and abstraction of heat to be made without chemical complications.

Under this diagram I have marked the leading particulars, including maximum and minimum temperatures, maximum and mean available pressures.

Here you will observe that with the same maximum pressure as in the Carnot cycle, and a very usual maximum temperature (1,700°C.) the mean available pressure is 105 lbs. per square inch, and the efficiency is ·48. Here the efficiency it is true is lower, but the available pressure bears a reasonable proportion to the maximum pressure, and the cycle is a thoroughly practical one.

If one considers this diagram carefully it will become evident that as both compression and expansion lines are adiabatic, that is, there is no heat addition or abstraction in the working fluid during compression and expansion, the proportion of heat converted into work of that given to the engine is correctly shown by the temperature rise on what I may

FIG. 3.

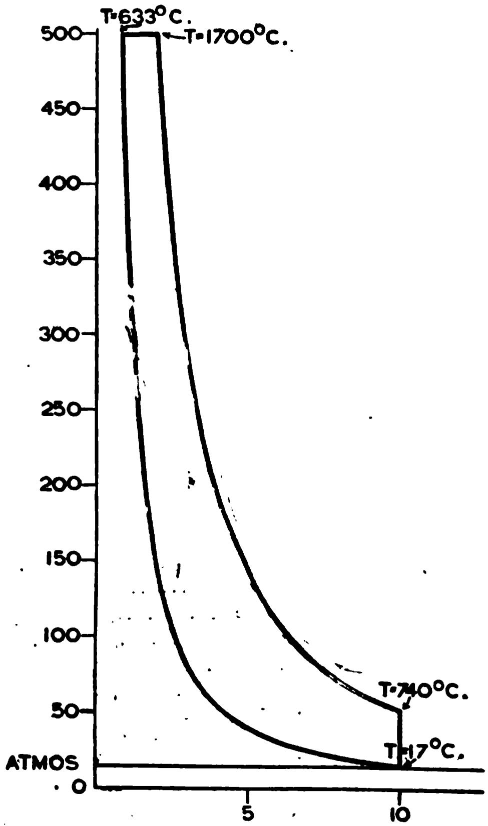


DIAGRAM FROM AIR ENGINE WITH HEAT ADDED AT CONSTANT PRESSURE AND HEAT DISCHARGED AT CONSTANT VOLUME.

Maximum pressure = 500 lbs. per sq. in.; mean pressure = 117 lbs. per sq. in.; maximum temperature = 1700° C.; compression temperature = 630° C.; exhaust temperature = 740° C.; minimum temperature = 17° C.; $\frac{1}{r} = \frac{1}{12\cdot 24}$; efficiency = ·61. (If expansion is carried to original pressure, efficiency = ·64.)

call the heat-addition line, as compared with the temperature fall on the heat abstraction line; that is, in this case the efficiency is also

$$\frac{T - T^1}{T}$$

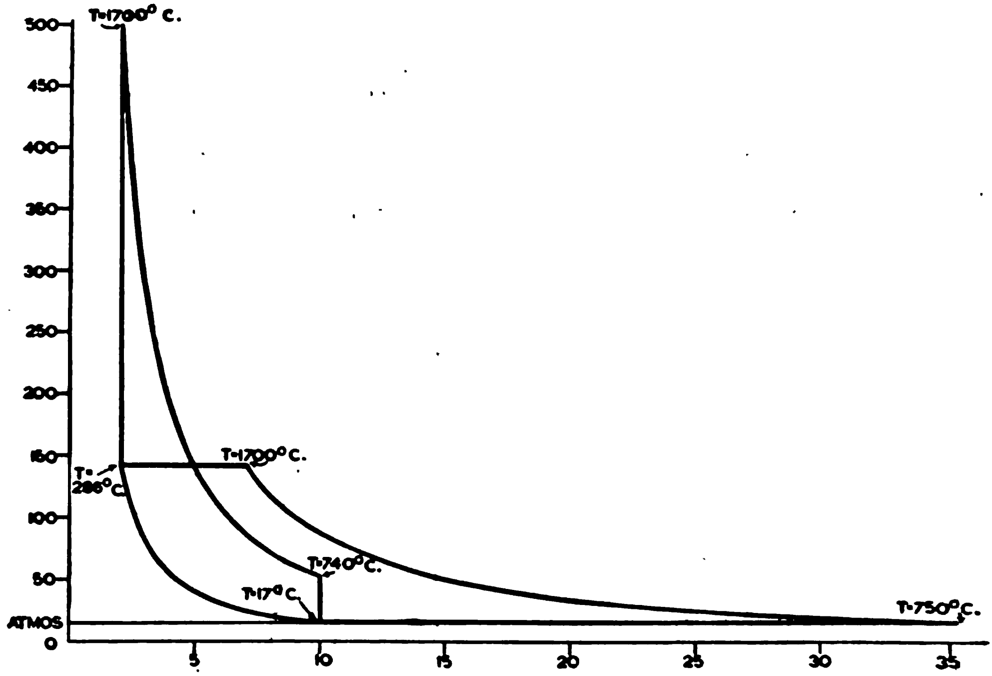
in this case, however, T being maximum temperature of heat addition, and T¹ the maximum temperature of heat discharge.

of compression. From this it follows that the efficiency can be expressed in terms of the volume before and after compression; and this worked out gives the efficiency formula as—

$$E = 1 - \left(\frac{1}{r}\right)^{\cdot 405}$$

In this particular case, $\frac{1}{r}$ is equal to $\frac{1}{5}$.

FIG. 4.



DIAGRAMS FROM CONSTANT VOLUME AND CONSTANT PRESSURE CYCLE AIR ENGINES.

	Constant Volume.	Constant Pressure.
Maximum temperature	1,700 C.	1,700° C.
Maximum pressure	500 lbs. per sq. in.	141·1 lbs. per sq. in.
Mean pressure	105 lbs. „	37 lbs. „
Efficiency	·48	·48

From the formula—

$$PV^{1\cdot 406} = \text{const.}$$

the value of the temperature at both ends of the diagram can be readily calculated for different maximum temperatures; and if you try various maximum temperatures you will at once find that on this particular cycle of operations the efficiency is the same for all maximum temperatures above the temperature of adiabatic compression; that is,

$$E = 1 - \frac{T^1}{T} \text{ or } 1 - \frac{t}{tc}$$

that is, the efficiency can be expressed in terms of the temperature before and after compression, and is independent of the increase of temperature above the temperature

and the efficiency would be ·48, that is, if 100 units of heat be given to an engine operating on this cycle, with these proportions, 48 of these heat units would be converted into mechanical work.

At Fig. 3 I have shown another diagram, which resembles the last two diagrams in one feature. The maximum pressure is the same. In this case, however, adiabatic compression has been carried to the maximum pressure, and heat is added, not at constant volume, but at constant pressure. In this diagram the engine performs the following operations:—Compression of initial volume of air to desired compression pressure, without gain or loss of heat, addition of heat to maximum tempera-

ture at the pressure of compression during expansion for a certain period; expansion without gain or loss of heat to initial volume, and discharge of heat at initial volume during fall of temperature to initial value.

Here a very high mean pressure is obtained, and the efficiency is but little lower than that given by the Carnot cycle. If the expansion in this case be carried far enough to cause the pressure to fall to the initial value, then the compression. This diagram clearly shows the relationship between the two cycles for the same compression and the same maximum temperature. In this case it will be observed that a greater expansion is necessary to obtain the same efficiency in the constant pressure case, and that in this constant pressure cycle the maximum pressure is lower. In this constant pressure cycle also the efficiency is the same for all heat additions above the tempera-

FIG. 5.

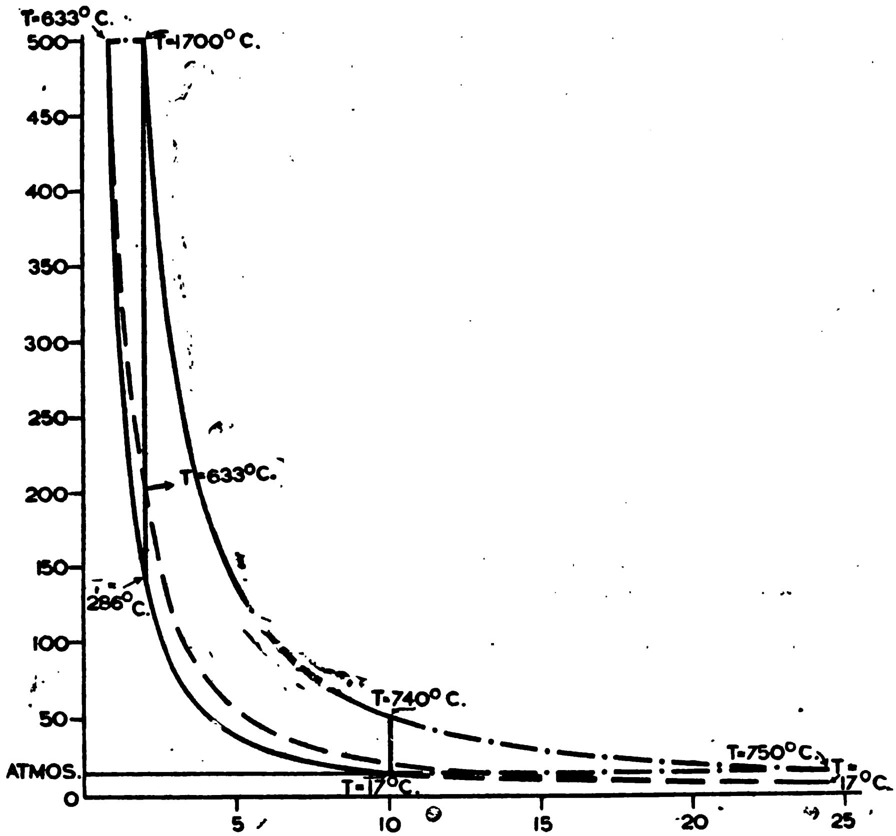


DIAGRAM FROM CARNOT, CONSTANT VOLUME AND CONSTANT PRESSURE CYCLE AIR ENGINES.

efficiency is given by the same formula as the constant volume cycle. It is ·64. The mean pressure, however, is much lower: it is only 56 lbs.; so that although there is a greater heat conversion, the engine is much heavier for the power.

This cycle may be called the constant pressure cycle, because in a perfect example heat is added and discharged at constant pressure.

Fig. 4 shows a constant volume cycle, such as is seen at Fig. 2, combined with a constant pressure cycle arranged for the same ture of compression, the condition of maximum efficiency for these circumstances being expansion to atmosphere. It is interesting to note that here we have the same efficiency formula for the constant volume and constant pressure cycles, the efficiency depending on the compression ratio only. The fact that these efficiencies were the same was first recognised by me in 1882, and for many years other engineers, notably M. Witz, of Lille, have also recognised this interesting fact.

Only a few weeks ago, however, Professor Callender pointed out that even in the Carnot cycle the efficiency is determined by the adiabatic compression line, and that it also has the same value for a given compression as is found for either constant volume or constant pressure cycles.

Fig. 5 gives a combined diagram, in which Carnot, constant volume and constant pressure cycles are shown, the feature common to the whole three, however, being that the maximum pressure is the same. In this case the Carnot cycle and constant pressure cycle have the same efficiency; but the constant volume cycle has a less efficiency. These diagrams, with the details marked under them, will prove useful to engineers designing gas engines, as showing pressures which would be given by ideal air engines corresponding closely to the different types; but the most interesting and important, from the manufacturing engineers' point of view, is, of course, that dealing with the efficiency of the constant volume cycle. This is the cycle which is followed in the majority of cases now. Only one constant pressure engine appears to be upon the market at present, viz., the Diesel oil engine.

Fig. 6 is a diagram which illustrates to you the efficiencies of constant volume engines at different compressions. A range of three diagrams is shown, in which the heat additions are all equal to one another, and equal to the heat addition illustrated in Fig. 2. This diagram at once shows clearly to the eye the fact that, as compression increases, greater conversion of heat into work results. This can be calculated from the formula:—

$$E = 1 - \left(\frac{1}{r}\right)^{\cdot 408}$$

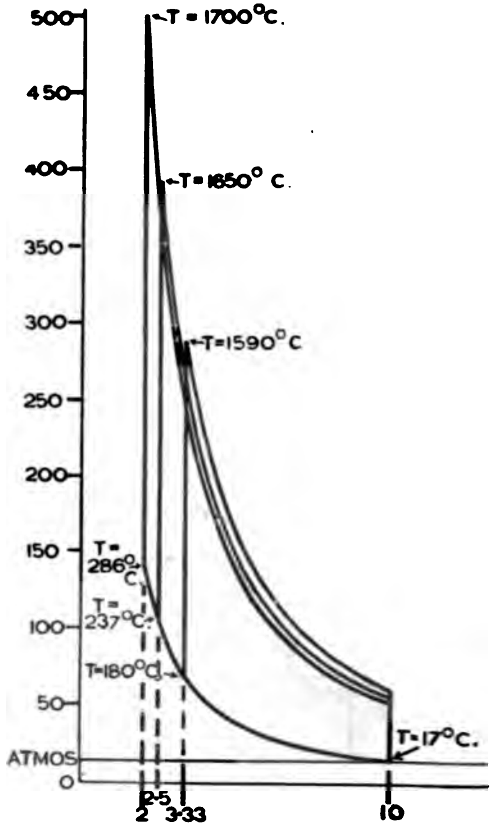
and I have made a calculation for the following values of $\frac{1}{r}$:—

TABLE I.

$\frac{1}{r}$	E
$\frac{1}{2}$	·246
$\frac{1}{3}$	·36
$\frac{1}{4}$	·43
$\frac{1}{5}$	·48
$\frac{1}{7}$	·55
$\frac{1}{10}$	·61
$\frac{1}{20}$	·70
$\frac{1}{100}$	·85

From these calculations it becomes at once evident that there is a very large thermodynamic gain, due entirely to increased compression or diminished compression space volume. The efficiencies range from compression space equal to $\frac{1}{2}$, giving an efficiency of ·246, up to compression space equal to $\frac{1}{100}$, giving an efficiency of ·85. These of course are efficiencies which could only be obtained in an ideal engine, assumed to exist without heat

FIG. 6.



DIAGRAMS FROM OTTO CYCLE AIR ENGINES AT DIFFERENT COMPRESSIONS.

	Maximum pressure per sq. in.	Mean pressure per sq. in.	Efficiency.
$\frac{1}{r} = \frac{1}{5}$	500 lbs.	105 lbs.	·48
$\frac{1}{r} = \frac{1}{4}$	391 lbs.	101 lbs.	·43
$\frac{1}{r} = \frac{1}{3}$	287 lbs.	97 lbs.	·36

losses of any kind, working with air having a constant specific heat, and so operated that no valve losses or throttle losses were incurred. I need not tell you that no actual engines give efficiencies so high as these for any given compressions.

I have already said that the increase of thermodynamic efficiency due to compression

is caused by something more than the increased expansion which is obtained. At first sight one would think that if a great enough expansion could be obtained with an explosion, say starting at atmospheric pressure, the same results should be given as we get with a corresponding compression and equivalent expansion. This, however, is not the fact. Mere expansion does not give the efficiencies obtained by adiabatic compression and then expansion. This appears to be due to the fact that by compressing a gas without loss or gain of heat, either at constant volume or constant pressure, the whole of the heat absorbed during the subsequent ignition is utilised for the purpose of doing the available work of expansion. This may be clearly seen by considering the case of an engine compressing not on an adiabatic line, but on an isothermal line. In this case, in addition to the heat added for doing the available work of expansion, there is a large proportion of heat added for doing that part of it which is unavailable. The reasons why compression, then, produces such great economies, are: (1) it allows of large range of expansion, and (2) it allows of the heat which is added being available for producing the work of the actual indicator diagram. It is somewhat difficult to grasp the abstract reason for the increase of efficiency due to compression, it will, however, from the above considerations, be clearly seen that adiabatic compression forms the basis of all perfect or approximately perfect heat engines. In actual practice, of course, there are other advantages than those flowing from increased efficiency. Compression enables high pressures to be generated within the cylinders, and so reduces the bulk of the engine. It further diminishes the proportional heat losses, and so tends to economy in the practical engine.

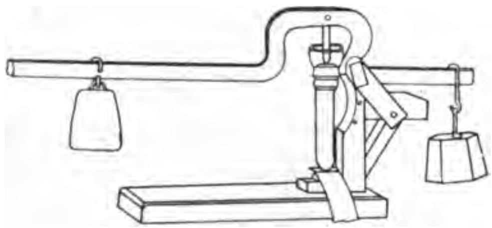
Before considering the question of actual efficiencies in engines, it is desirable to understand to some extent what goes on in a gaseous explosion.

If air at a temperature of 0°C. and atmospheric pressure be confined within a closed space, say a closed vessel, and then heated, for every increase of temperature of 1°C., the pressure will increase by 1/273; that is, when the temperature is raised to 273°C., the pressure within the vessel will have increased to 2 atmospheres. At a temperature of 546°C. the pressure would be 3 atmospheres; and the pressure will continue rising with the temperature, so that at a temperature of 2,184°C. the pressure of our confined air will have risen to 8 atmospheres. This increase of pressure will occur in whatever way the air be heated. The air might be heated by heating the enclosing vessel; or by heating by means of, say, electric currents passing through platinum wires, or by internal combustion. This is practically what happens when gas is mixed with air, and the mixture then ignited within a closed vessel.

Professor Bunsen, the great German chemist, long ago proposed this method of determining the temperature produced by gaseous explosion.

Fig. 7 shows the apparatus which Bunsen

Fig. 7.



Bunsen's Apparatus for determining the Temperature of Explosion.

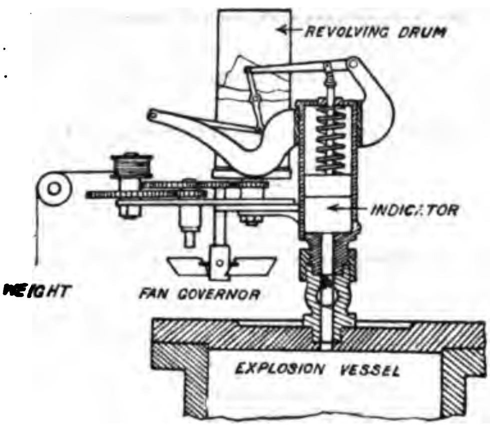
used in the year 1866. Bunsen enclosed a certain volume of explosive mixture in the small tube shown in that figure, and he weighted a valve which closed the upper part of the tube, so that the valve just blew off when the mixture was exploded by an electric spark. The pressure at which the blow-off took place he considered to be the maximum pressure of the explosion, and from that pressure, calculating exactly in the way I have described, he determined the temperature of the explosion flame.

Many years ago, I made experiments similar to Bunsen's by means of an apparatus shown at Fig. 8; and recently I have made experiments with a new apparatus of a different type, the results of which I show at Fig. 9. The apparatus consisted of a cylinder having strongly bolted covers. Upon the upper cover is placed a Richards indicator, and the pencil acts upon a rotating drum, which drum is operated by clockwork, and a record is produced which is afterwards copied from the drum. The rising line which you see traces the progress of the explosion, and the falling line the progress of the cooling. The rate of revolution of the drum being known, the interval of time elapsing between the periods of the explosion or cooling curve is also known. These experiments clearly proved that a

gaseous explosion produces a maximum temperature close upon 2,000°C., and this temperature is produced by pressure slightly over 100 lbs. to the square inch above atmosphere. These experiments were first published by me in 1886.

To get quite accurate results, it is necessary

FIG. 8.



CLERK EXPLOSION APPARATUS.

to allow for chemical expansion or contraction, and this question of chemical expansion or contraction is the principal one, apart from heat value, which determines the difference in behaviour of different gaseous explosions.

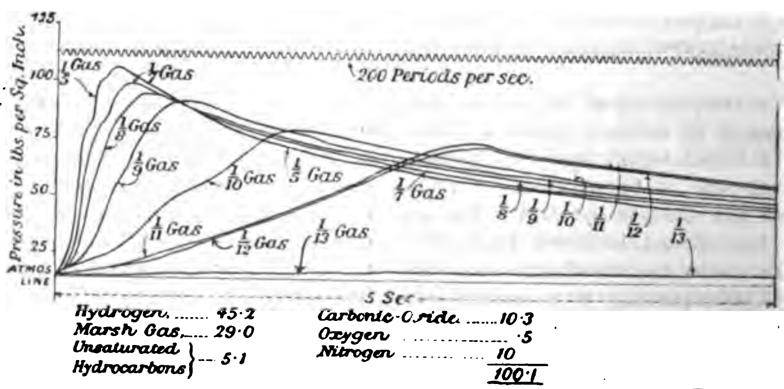
So far, most of the work which has been done on gaseous explosions with a view of determining the maximum temperature and cooling curve for different mixtures, have been made with coal gas and air mixtures. Little is known of the cooling curve of petrol, alcohol, and producer gas explosions, except from the behaviour of such gaseous mixtures in the engines.

Table II., however, shows the difference which may be expected from these explosions, so far as chemical contraction is concerned. One feature, however, stands out clearly in connection with all these gaseous explosions. That feature is, the apparent suppression of part of the heat of the gas or vapour present at the maximum temperature of the explosion; that is, if the maximum temperature of the explosion be calculated, and it be assumed that the specific heats of the products are constant, then it will be found that the heat evolved by the temperature rise is not equal to that of the gas present. This fact has led to a great deal of discussion among engineers, chemists, and physicists. Some, including many French experimenters, say that the specific heat of air and other gases changes largely at high temperatures, and that the whole heat is evolved at a maximum temperature, but specific heat varies. Others say that the explosion experiments cannot prove this, and that although maximum temperature is obtained, combustion is not completed at that temperature, but goes on for some time after maximum temperature. Others, again, say that dissociation of carbonic acid and water intervenes, and prevents further evolution of heat till temperature falls.

In discussing the application of the theory of compression to the actual efficiencies of internal combustion motors, it is desirable so to arrange matters as to avoid the necessity for accepting any particular theory. In these lectures I propose to do this.

It is desirable, however, always to bear in mind that although for simplicity's sake we discuss internal combustion engine problems as if we had to do with an air engine pure and simple, yet in considering the actual conditions

FIG. 9.



CLERK EXPLOSION CURVES FOR VARIOUS MIXTURES OF LONDON COAL GAS.

of practically operating engines, the problem is very much more complex. The amount of heat not accounted for by the temperature rise in gaseous explosions, assuming constant specific heat, varies from 30 to about 50 per cent., depending upon the strength of the explosive mixture. If the mixture be approaching the maximum flame temperature, then a large proportion of heat remains unaccounted for. On the other hand, if the mixture be approaching the point of missing firing by over dilution, then heat unaccounted for is equally great. The greatest proportion accounted for is found with intermediate mixtures, such as mixtures of coal gas and air ranging from 1 in 10 to 1 in 12. These are the mixtures which are most economically used in coal gas engines. To understand the conditions of economy, however, it is well to simplify the problem as much as possible. The diagrams reproduced above are the diagrams which a pure air engine would produce, if the specific heat of air were constant at maximum temperature, and if no heat losses whatever were incurred by the contact of the flame with the cylinder; and, further, if no valve losses were incurred, due to throttling during admission, or back pressure during exhaust. These matters I propose to deal with in the next lecture; but meantime we shall confine ourselves to the simplified problem, assuming certain heat losses.

Taking, for example, the constant volume engine, of which the diagram is shown at Fig. 2, this engine, as you see, without heat or other losses, would convert 48 out of every 100 heat-units given to it into indicated work. Assume now one simple case of heat loss, that is, heat loss during the expansion stroke only; and assume a phenomenon similar to the actual case in the gas engine cylinder, that is assume the expansion line to be apparently adiabatic, although in reality heat is flowing away to such an extent that an equal quantity requires to be added during expansion to that which is added at the beginning of the stroke. In this case, it is evident that the calculation for the actual efficiency of the engine is a very simple one. Instead of adding 100 heat-units, 200 have been added, and from these 200, only the work shown upon the diagram has been given. The practical efficiency of this engine would therefore be given by multiplying the ideal efficiency by ·5, that is, half of the ideal efficiency would give the practical efficiency.

If the expansion line be above the adiabatic, the problem is by no means so simple, because here, even without heat loss, the efficiency of the expansion is greatly reduced.

In the James Forrest Lecture, which I had the honour of delivering to the Institution of Civil Engineers last year, I calculated a number of cases of this kind, and showed that the efficiency suffers considerable reduction by the addition of heat in the expanding line, to keep up an expansion above the adiabatic. In a case of this kind—a case which indeed occurs in practice in large gas engines—it is necessary to calculate the efficiency on the assumption of expansion above the adiabatic, in order to find the real efficiency of the engine which is under examination.

TABLE II.—Relative Volumes of Combustible Mixtures with Oxygen and Products of Combustion.

8 vols.			8 vols.
2 vols. Ethylene C_2H_4	+ 6 vols. O	give	4 vols. CO_2 + 4 vols. H_2O
14 vols.			16 vols.
2 vols. Butylene C_4H_8	+ 12 vols. O	„	8 vols. CO_2 + 8 vols. H_2O
17 vols.			20 vols.
2 vols. Pentane C_5H_{10}	+ 15 vols. O	„	10 vols. CO_2 + 10 vols. H_2O
18 vols.			20 vols.
2 vols. Pentane C_5H_{12}	+ 16 vols. O	„	10 vols. CO_2 + 10 vols. H_2O
24 vols.			30 vols.
2 vols. Heptane C_7H_{16}	+ 22 vols. O	„	14 vols. CO_2 + 16 vols. H_2O
27 vols.			34 vols.
2 vols. Octane C_8H_{18}	+ 25 vols. O	„	16 vols. CO_2 + 18 vols. H_2O
8 vols.			10 vols.
2 vols. Alcohol C_2H_6O	+ 6 vols. O	„	4 vols. CO_2 + 6 vols. H_2O
7 vols.			6 vols.
2 vols. Acetylene C_2H_2	+ 5 vols. O	„	4 vols. CO_2 + 2 vols. H_2O

The other engine cycle, *i.e.*, the constant pressure cycle, is one which is also subject to heat loss, but as a considerable part of the work is done during increasing temperature, the heat loss per stroke is somewhat less than in the constant volume cycle, and accordingly some advantage results.

Much has yet to be done, before all the actions going on in the cylinder of the internal combustion motor can be fully understood; and if we hold clearly in our minds the efficiencies possible with engines suffering no heat losses, subject to no complications as to chemical action or change of specific heat, we shall hold a key which will guide us through many complexities, and will supply clear indications of the line of advance. To advance quickly, it is necessary to understand fully, and many experiments yet remain to be made to enable us to understand the peculiarities of the numerous different gaseous and vapour explosions now utilised in these engines. Experiments have still to be made upon the specific heat of the products of combustion at high temperatures, the laws of cooling of the flames within the cylinders, the laws of combustion, proceeding at the enormous rates experienced in these engines. Especially urgent is the requirement for explosion and cooling curves for coal gas, petrol, alcohol, producer gas, and blast furnace gas explosions. Some of these matters, however, I propose to deal with in considering the indicator diagram in my next lecture.

BRITISH TRADE IN SIBERIA.

It is just two years since Mr. Henry Cooke left Moscow for Siberia, to inquire into and report upon the present position and future prospects of trade in Siberia, more especially with reference to openings for British enterprise. Mr. Cooke undertook his mission on behalf of the Commercial Intelligence Department of the Board of Trade, and the outbreak of war between Russia and Japan so altered the conditions prevailing in a great part of the country visited that the Board of Trade thinks no good purpose would be served at present by publishing the results of Mr. Cooke's inquiries so far as relates to the Far East. Accordingly, the present Report is entirely confined to Siberia, west of Lake Baikal. It is a voluminous and highly interesting document, and deserves the very careful consideration of business men. The Report is calculated to dispel the associations with which Siberia has hitherto been almost exclusively connected, and to encourage Englishmen in search of new markets and trade openings to personally examine, in the country itself, the possibilities it presents. The American, the Dane, and the German are there already, and have captured some of the most fruitful fields it affords for enterprise. If what remains does not at present offer any vast opening for special branches of British energy, it is at least not a market to be passed by. "These rich regions," says Mr. Cooke, "will be to Russia's mighty millions what our Colonies are to the British Isles. They will harbour her surplus populations. Even now Russian immigrants into Siberia, peasants though they be, are supplying the London market with butter, and as they reap their crops with American harvesters, discuss with intelligence the rival performances of machines from Milwaukee or Chicago."

Mr. Cooke's description of the British position in the commercial rivalry of the nations for Siberian trade is not pleasant reading. It is but natural that Russian firms should start branches in Siberia or found independent enterprises. But foreigners too are active and successful. The Danes and the Americans have worked wonders in two branches of the agricultural conditions of the country. The Germans give proof of their capacity to study and adapt their ways and wares to the customs and requirements of the inhabitants. The Swedes share with the Danes the market for dairy accessories. The French have seized something of the demand for fancy goods and toilet articles, the Belgians for guns, and the Austrians for scythes and sickles. Englishmen maintain their reputation for first-class quality in a variety of goods, and for the high price which precludes their adoption. And the irony of it is that it is Great Britain that for the most part furnishes the funds that enable the Siberian peasants to provide themselves in increasing abundance with separators and dairy appliances from Denmark and Sweden, and with agricultural machinery from the United States. The British manufacturing market supplies nothing, and these two branches of trade afford, in Western Siberia at least, the principal and indeed the sole opportunities that have hitherto arisen for foreign importation of any appreciable extent.

Nothing is more remarkable in the commercial history of the last generation than the growth of the butter-making industry of Western Siberia. It is one of the first results of the construction of the railway, and from the point of view of the general well-being of the peasant population the most promising outcrop of the conditions now prevailing. It is at present the main resource of the inhabitants of the entire region. During the succession of bad harvests previous to last year, which crippled the earnings of the peasants and entailed a general stagnation of business in a country exclusively dependent on the crops as Western Siberia, the income derived from the sale of their milk and butter saved the peasants from much of the suffering and destitution that must otherwise inevitably have befallen them. Previous to 1893 no butter was produced in Siberia for export abroad. The first to make butter under modern

methods in Siberia was an English woman married to a Russian, whose dairy farm at Chernaia Reitchka in the district of Tiumen, was in 1886 the only one in Siberia, and is still a well-known model of its kind. The initial difficulties encountered must have been very depressing. No experienced hands were to be found, the peasants did not understand that cows had to be properly fed or attended to, the distances were enormous, and communications were non-existent or primitive, while the people in general had but faint ideas as to the difference between cheese and butter and how they were to be eaten. In 1893 Mr. Wolkoff, a Russian, opened near Kourgan the first dairy producing butter for export beyond the Urals: 14,400 lbs. were exported in 1894. Ten years later butter-making had become the staple industry of the country as regards international trade, and the chief resource of its peasant population. Over 2,000 dairies are now scattered over Western Siberia, their export in 1903 being 2,185,000 pouds, or 78,904,720 lbs. Butter, thanks solely to the Siberian supply, now occupies the sixth place in value in the Russian export trade, and promises to exceed all other items except grain. The British market is Siberia's largest customer, Denmark acting as a forwarding agent. In 1899, the import from Russia was so inconsiderable as to be merely included in the Board of Trade returns under "other countries." In 1900, it forced its way to an individual heading, the exports from Russia amounting to 378 452 cwts. Last year, the butter exports from Russia, mostly from Siberia, were valued at about 30,000,000 roubles.

Unfortunately, as Mr. Cooke shows, Great Britain, though the largest producer of the manufactured product, has no share in supplying the dairy accessories in local demand. "The parchment used for packing the casks is Russian, Flemish, or German. The casks are made locally from beach staves, imported mostly from Germany by rail, though also from Denmark. The colours used for colouring the butter the yellow tinge required by the British market are chiefly Danish, though Russian colours are also in use. . . . The separators are almost entirely Danish, or Swedish, a well-known Stockholm article easily holding the field." Agents of the Stockholm and Copenhagen makers of dairy appurtenances work the country thoroughly, and every butter office is a practical advertisement of their articles. The price lists, catalogues, instructions, illustrated sheet advertisements, and coloured pictorial representations of the machines at work are met with in all directions, and are all in the Russian language, with moneys, measures, weights, dimensions, &c., in equivalents understood by the people.

It is much the same with agricultural machinery. Here the Americans have made the market their own. The vast expanses of their own continent, and somewhat similar conditions of cultivation, give them an advantage in competition with other nations. The distinguishing characteristics of the machines are lightness, simplicity, and ease of use, while stress of competition has reduced prices to the means of the peasant cultivator. Mr. Cooke says that the almost universal monopoly acquired by the United States is shown on interviewing the owners or managers, examining their stores, or studying their catalogues. "Russian and American," not "Russian and Foreign," machines are everywhere advertised. American machines are at almost every depot, Russian manufacturers, at their own establishments, exhibiting them alongside their own similar articles. What competition there is bears an inter-American rather than an international character, New York, Chicago, Auburn, Milwaukee, and other contending centres of manufacture disputing the field. "This new and promising market," says Mr. Cooke, "has been conquered by a careful study of the requirements and peculiarities of Siberian climatic and trading conditions generally, and especially of the demands, preferences, and prejudices of the peasant, who is the sole buyer. The machine is made for the man, and not the man for the machine." It is worthy of note that, including the extreme Far Eastern ports, there is no American official of any kind in the length and breadth of Siberia.

In Siberia proper, Germany has the larger share of the general machinery market, apart from agricultural, though it is rivalled by the United States and Great Britain in Far Eastern ports. The chief causes of German predominance would seem to be (1) superior cheapness, (2) lightness and general correspondence of goods to requirements, (3) greater pushing of goods and willingness to accept business however small as well as to meet all possible suggestions and adaptations, (4) the presence of German resident firms or business men at the bigger centres and periodical visits of representatives, (5) the greater currency of the German language in business circles, the practical nature of their catalogues, price lists, and terms, the facilities they proffer, the initial risks they are willing to run in order to start business, and in general their undoubtedly superior knowledge of the country and its business customs and ways.

Mr. Cooke's explanation of the failure of British traders to get any considerable portion of the Siberian trade has little that is novel in it. British goods are not pushed, or the requirements of the market studied. "Much is lost by not pushing English goods. They have to be sought even when they are heard of at all. British articles are neither accessible nor forthcoming, and in Siberia it is the article on the spot that is bought. British catalogues are not drawn up for Siberian customers, but such as appear in Siberia are looked upon as undecipherable puzzles. Among other things, the exact weight, gross and net, so important for calculating duty and freight, is seldom given, or is given in intricate figures and measures. It is a trite subject, but I can but repeat what I have heard everywhere. 'The English are too proud,' was a favourite expression of opinion, though German

rivals in some centres employed another term, implying inaction. It is only natural, however, from the very nature of the country, its distances, and its population, that the articles which sell are those that are brought there, and not those that have to be first heard of, and then sought out and ordered through second or third hands." Add that in a country where all trade is on a credit basis the British trader requires cash and eschews cheapness, and it is not surprising that British exports to Siberia remain comparatively insignificant. "Sure, solid, and select," says Mr. Cooke, "would seem to characterise British business activity, but the range thus covered is a circumscribed one."

THE AUSTRALIAN MEAT TRADE.*

Within the last few years beef and mutton have become staple articles of Australian export, yet it is not so very long ago when such a result was deemed impossible, at any rate so far as shipments of fresh meat were concerned. For a considerable period the over-sea consignments consisted of tinned meats, for which there would have been a larger demand had the tins presented a more attractive appearance and been of smaller size. With the establishment of regular and speedy steam communication between Europe and Australia, accompanied by the necessary provision of cold-storage accommodation, the Australian meat export trade became rapidly developed. the quantity shipped in 1903 being 102,925,879 lbs., value £1,402,993. Two years previously, in 1901, the quantity was 189,263,239 lbs., value 1,989,455, the drought being responsible for the shortage in 1903, which is disappearing during the present year. The whole of the shipments are made from Victoria, New South Wales, South Australia, and Queensland, the latter State furnishing most of the beef, which is of first-class quality, by reason of the abundance of rich pasturage available. In 1903-4, there were 2,481,717 head of cattle in Queensland, against 4,622,978 head in the other States. There are extensive areas of luxuriant grazing country in the Kimberley district in Western Australia, also in the northern territory, but in the latter the rapidity with which the ground becomes covered with dense scrub constitutes a source of difficulty. In the number of sheep New South Wales leads the way with 28,656,501, Victoria following with 8,774,731, Queensland with 8,392,044, South Australia with 5,350,258, Western Australia with 2,600,633, and Tasmanian with 1,597,053 forming a total of 55,371,220. In 1891 the number was 106,421,168, the decrease being a result of the great drought, which was not, however, an unmitigated calamity, because when the number of sheep is unduly large the quality of both meat and wool must necessarily be inferior. With fewer sheep and abundance of feed the conditions become reversed. At the present time the great object of Australian pastoralists is to secure quality in preference to quantity. In 1904-5 there was a considerable increase in the number of sheep, and it is anticipated that within the next few years the figures of 1891 will be approached, unless pastoralists, profiting by the experiences of recent years, refrain from overstocking. The importance of the pastoral industry is recognised in all the States, and in New South Wales the land laws are being amended with a view to stimulating pastoral as well as agricultural production. The work of meat slaughtering and preserving is conducted on an extensive scale. In New South Wales the capacity of the boiling-down works is stated at 633,900 head of cattle, or 16,965,000 sheep; of chilling works, 488,500 head of cattle, or 5,422,800 sheep; of freezing works, 75,500 head of cattle, or 3,150,000 sheep; and of preserving works, 183,000 head of cattle, or 5,545,000 sheep; representing a total of 1,400,900 head of cattle, or 29,982,800 sheep. The number of carcases treated in refrigerating works during 1903 was 3,666 cattle and 299,131 sheep; and in meat preserving works 7,794 cattle and 188,248 sheep. In Queensland there were 16 boiling down, freezing and other works, in which, during 1903, 922 cattle and 110 sheep were boiled down; 108,343 cattle and 102,007 sheep killed for freezing; and 16,409 cattle and 13,309 sheep killed for preserving; the total output being 66,483,364 lbs. frozen beef, 4,906,991 lbs. frozen mutton, 9,773,112 lbs. preserved beef, and 498,416 lbs. preserved mutton. In Victoria there were 14 freezing, &c., establishments, the united output in 1903 including 294,906 frozen sheep, 7,237 cwt. frozen mutton, 1,424 frozen cattle, and 7,237 cwt. preserved mutton. The meats are exported in four different forms—fresh, frozen, chilled, and smoked. The trade in fresh meat is almost wholly inter-State. Respecting the relative merits of chilled and frozen meats, there exists considerable difference of opinion, but, as a matter of fact, frozen meat constitutes the bulk of the over-sea exports, chiefly to Europe and South Africa, being greatly appreciated in the latter country, where it commands a ready sale in preference to that from elsewhere. The exports of Australian preserved meats in 1903 totalled 11,009,277 lbs., value £108,802. Considerable quantities of salted meats are also exported, chiefly to South Africa and the Philippines. There is likewise a large and increasing trade in rabbits, hares, &c., the quantities exported in 1903 being—New South Wales, 787,574 pairs; South Australia, 119,362 pairs; Victoria, 3,501,511 pairs. In 1904, the Victorian exports were about the same as in 1903. It is officially stated that the rabbits are steadily increasing in numbers in Queensland, New South Wales, and Victoria, and in the two former States they constitute a prolific source of difficulty to pastoralists. Their fecundity is truly remarkable.

* Communicated by Mr. John Plummer, Sydney, New South Wales.

A single pair of rabbits, if left undisturbed, will, all things being favourable, have augmented their numbers to four and a half millions in four years.

TRADE OF JAPAN.

The report on the trade of Japan for the year 1904, just issued by the Foreign Office, and prepared by Mr. G. Barclay, Secretary to His Majesty's Legation at Tokio (No. 3,377, Annual Series), shows that, thanks to the long period of cautious trading which followed the economic crisis of 1899-1900, Japan's trade was in a thoroughly healthy condition when war broke out, and since then it has suffered comparatively little. Not only has Japan been in almost uninterrupted possession of the command of the neighbouring seas so that her foreign trade has not suffered serious inconvenience from the enemy's cruisers, her crops last year were very abundant, the yield of rice and silk being higher than ever before. Owing to these circumstances Japan has hitherto borne the strain of the war with remarkable ease. Her foreign trade has reached a level not only in imports but also in exports considerably higher than that of any previous year. Particular industries have suffered, notably the silk manufactures for the home market, and the smaller manufacturers and traders have many of them felt the pinch of restricted credit, but the year has passed without any failures of importance. On the other hand many industries, particularly farming and silk manufactures for the foreign market, as well as those industries which have helped to supply the war's requirements, have enjoyed a period of great prosperity. It has been the policy of the Government, says Mr. Barclay, to purchase as much as possible in Japan—it has been asserted that 70 per cent. of the war expenditure has been spent at home—and there are many examples of struggling industries which have been built up into successful concerns by the large demands on their capacity.

Mr. Barclay thinks it reasonable to assume that the payment of the successive instalments of the domestic loans already floated, amounting to £28,570,000, and the additional taxation imposed by the Diet, will suffice to prevent any serious inflation of the currency. The additional taxation amounts to some £7,500,000 for the year 1905-6, bringing the total increase in the people's burdens from the beginning of the war to nearly £14,000,000, or something like 81 per cent. of the total revenue from taxation in 1903-04. How far the country's general industries will be able to bear these increased taxes, of which one is an import duty of 15 per cent. *ad valorem* on rice, remains to be seen, but the ease with which the domestic loans have been taken up, and the fact that the deposits in the leading banks and the Post Office banks show material progress for the year are hopeful symptoms. The following table shows the deposits at the end of 1904 as compared with December, 1903:—

Deposits in the	Amount. December, 1904.	Amount. December, 1903.
	£	£
Bank of Japan	1,268,000	400,000
Tokio Associated Banks	15,830,000	14,456,000
Post Office Savings' Bank	3,891,000	3,191,000

It will be seen from the following table, compiled by Mr. Barclay from the Finance Department's Monthly Customs Returns, that, as compared with 1903, the increase in the total volume of Japan's foreign trade, as recorded in the Customs, amounted during the past year to £8,566,159, or nearly 14 per cent. Imports increased in value by over £5,500,000, or 17 per cent., and exports by over £3,000,000, or 10 per cent.:—

Years.	Value. Imports.	Value. Exports.	Value. Total.
	£	£	£
1904	37,902,567	32,591,216	70,493,783
1903	32,374,250	29,553,374	61,927,624
1902	27,739,232	26,368,320	54,107,552

Briefly speaking, it may be said that the imports which show declines, and the exports which show most progress, were manufactured or partly-wrought products—a very satisfactory indication of the development of the native industries.

The following table shows approximately the gold reserve and note issue of the Bank of Japan at the close of 1904, and the two preceding years:—

Years.	Gold Reserve.	Note Issue.
	£	£
1904	8,525,000	29,200,000
1903	11,930,000	23,750,000
1902	11,010,000	23,540,000

The value of imports from the British Empire was 24 per cent. higher in 1904 than in the previous year, its share in Japan's Customs amounting to 41 per cent. of the whole, as against 39 per cent. in 1903. The Empire still maintains the second place as a customer of Japan, though her share in the total exports has fallen from 23 to 21 per cent. Having regard to the United Kingdom's position as the principal source of supply for ships, for steam coal, and for certain classes of textiles, needed for army purposes, it is not surprising that, in 1904, she should have had a much larger share in Japan's custom than in ordinary years, and, in effect, Japan has taken from her 54 per cent. more than in 1903, the value of the increase being £2,681,000, or 48 per cent. of the total increase in Japan's imports. With 20 per cent. of the total imports the United Kingdom has resumed her place at the head of the list which she had always held until India passed her in 1903. The strengthening effect which the demand created by the war has had upon certain branches of Japanese industry applies with special force to the workers in cotton mills. For these 1904 was so prosperous that several of them have planned important additions to their establishments. Six of them have set up 1,800 new power looms, an addition of nearly 50 per cent. to their present plant. It is very possible, Mr. Barclay thinks, that for some

time to come the imports of fancy textiles will not be materially affected, "but in the cheaper cottons and woollens British manufacturers must be prepared not only for the loss of the Japanese market, but also, what is more important, for keen Japanese competition in China." The figures for the year indicating, as they do, increased imports into this country of certain lines of textiles which Japan is well able to produce in sufficient quantities for normal use herself, must not be taken as any guide for the future. 1894 saw no interruption in the constant decline in the foreign yarn trade, which has marked recent years. There has been practically no demand for this British staple, except for 16's and 24's, which are used for special purposes, and the value of the trade, which a few years ago used to average close on £1,000,000, has now fallen to £35,000.

The figures for machinery and engines are fairly satisfactory in 1904 as compared with 1903, but less so if the comparison is for a longer period, as will be seen from the following table:—

Values.

Year.	United Kingdom.	United States.	Germany.
	£	£	£
1901	659,000	288,000	187,000
1902	335,000	285,000	112,000
1903	415,000	294,000	82,000
1904	492,000	371,000	115,000

The Americans are able to deliver quicker, partly because of larger capacity and partly because many standard machines are kept in stock, and they possess a great advantage by reason of their supremacy in electrical machinery. In some branches, such as textile machinery and heavy machinery, the United Kingdom maintains its pre-eminence, but in the great variety of smaller machines both the United States and Germany are competing strongly. Mr. Barclay points out that not only in machinery but in many other articles, the buyer of American goods is better able to estimate ultimate cost than in the case of British manufactures. "The American maker generally issues priced catatogues, and will state discount in an accompanying letter; his prices are usually for machines packed and delivered on the cars. The American railway company taking charge of the goods will quote a through rate of freight per 100 lbs. from the factory to the port of destination." Given an American catalogue with the discounts, the weights of the machine, and the through rate of profit, it is an easy matter to estimate the laid-down cost. Many British manufacturers will not quote discounts except against specific enquiries. Packing is often an unknown extra. So are the rail and steamship charges. As a result the resident merchant finds it difficult to quote prices without a reference home, and thus many an order finds its way to America because the total cost can easily be reckoned, and a price quoted without delay.

Of the tonnage crossing the Pacific between Japan and North America in 1904, 41 per cent. was under the British flag, but Mr. Barclay shows that these figures do not fairly represent the situation. The only wholly British line on the trans-Pacific trade having regular sailings is the Canadian Pacific, with an average tonnage despatched last year from Yokohama to Vancouver of 65,862 tons, or 15 per cent. of the total. The 20 British sailings from San Francisco and Portland, aggregating 48,893 tons, were under charter to American trans-continental railways, and of the steamers under the British flag which left at irregular intervals for Tacoma, Victoria, and Paget Sound, 12 in all, aggregating 54,097 tons, the majority took cargo from Japan engaged for them by the Japanese steamship companies, whose steamers, in consequence of the war, had been temporarily withdrawn from the Pacific. German shipping, with 15 per cent. of the total foreign tonnage, shows an increase of 24 per cent. The establishment by the North German Lloyd of a service between Australia and Yokohama, calling at the German New Guinea ports, deserves special mention.

CARE OF THE AGED IN BELGIUM.

Under the law of May 10th, 1900, it was provided that a pension of 65 francs (£2 12s.) should be granted to every Belgian workman being in a state of need, and having his residence in Belgium, who had reached the age of 65 on January 1st, 1901. Workmen who were at least 55 years of age on January 1st, 1901, were to be allowed the same privileges when they reached the age of 65, but those under the age of 58, at the same date, were excluded from the benefit of the grant, if for a period of at least three years they should not have made deposits with the Government annuity fund of at least 4s. 9d. a year, forming a total of 14s. 3d. The qualifications for receiving the annual pension of £2 12s., are as follows, according to a recent report by the United States Consul-General at Antwerp:—(1) The pensioner must be a Belgian subject; (2) must reside in Belgium; (3) must be at least 65 years old; (4) must be, or have been, a labourer; (5) must be in want. Labourers, for the purposes of this Act, are defined as men and women who work for wages with their hands, for a master, and are paid for their time, or by the piece; and who work on the premises of the master or at home. No distinction is made between the domestic servant, the farm labourer, and the factory hand. Those whose past life corresponds with the above definition, are considered ex-workmen. The wife or the widow of a labourer or ex-labourer is, for the purposes of this Act, also considered a labourer. Those are considered to be in need, for the purposes of this Act whose resources are insufficient to meet their obligations without assistance, and to establish this qualification the following circumstances are taken into consideration. (1) The wages of the interested

person, of his wife, and of his children, and his relatives living with him; (2) the value of their personal property and of the premises which they rent; (3) the nature of their savings, if any; (4) the amount of public charity received, &c.; (5) the cost of house-keeping compared with that of the other labourers in the same trade and in the same neighbourhood, taking into consideration the number and age of those who compose the family; the care of the infirm and sick; (7) rent, taxes, &c.

All foreigners, no matter what may be the legislation of their country, or the length of their residence in Belgium, are excluded from the benefits of this law, unless they have become naturalised. However, a foreign woman who marries a Belgian, becomes a Belgian subject and remains such even after the death of her husband, so long as she resides in Belgium. All who solicit the old-age pension must make their request in writing to the burgomaster of their city, town or village before January 1st of the year during which the pension is to begin. The application must give the name, age, nationality, profession, and residence of the person, as well as a full description of his financial circumstances. The burgomaster will then refer the application to what is known as the committee of patronage, a local body which has under its supervision all matters relating to workmen's dwellings and charitable institutions. It is the committee of patronage which decides upon the merits of all applications and which advises the applicant and the governor of the province of its decisions. From the finding of the committee there is an appeal to the governor of the province. The final decisions are transmitted by the governor to the Minister of Industry and Labour at Brussels, and the Bureau of Labour orders the payment which is made in two instalments of £1 6s. through the local post offices, where the beneficiaries must appear in person and sign their receipts. The Department of Commerce and Labour sends to the Burgomasters during the month of January of each year a list of the persons residing in their districts who receive the pension. The burgomaster notes on his list all deaths, and changes of residence, and any change in the financial circumstances of a pensioner which may have taken place. If the condition of a pensioner is found to have improved during the year, and he is able to maintain himself, the pension ceases. This pension of £2 12s. per annum does not prevent the pensioner from receiving further relief from the board of public charity. No person of the age of 65 may be considered in want whose revenue for his own use amounts to £14 per annum, and no married couple of the age of 65 can be considered in want and receive benefits under this Act whose joint income amounts to £24 per annum. *Employés* of the State, especially postmen, rural police, &c., who are pensioned by the State treasury cannot be considered as labourers under this Act, but those having been employed by the Government railway may be so considered. The number of old age pensioners now on the list and receiving aid from the Belgian Government is something over 200,000.

CONSUMPTION OF HORSEFLESH IN GERMANY.

The increasing consumption of horseflesh among a large class of people of moderate means in Germany, many of whom eat fresh meat of any kind only on Sundays and holidays, has been specially remarked upon. There is in the Greifswalder Strasse, Berlin, a regularly installed horse slaughterhouse, which is under careful police supervision with a veterinary surgeon in attendance to see that no animal is killed, the flesh of which, by reason of disease or other cause, would be unfit for human food. In 1895 the whole number of horses killed in Berlin for human consumption was 7,267. In 1900 the number had increased to 10,815, and in 1904 to about 13,000. Estimating that an average sized horse will yield 230 pounds of edible flesh there was derived from this source last year about 2,990,000 pounds of meat, which was sold for consumption in 64 shops which are specially licensed for that purpose. The United States Consul-General says that at Breslau, which has a population of about 500,000 against 2,500,000 in Berlin and its suburbs, 3,800 horses were killed last year for human food, so that the proportion of horseflesh eaten per capita was much larger in Breslau than in Berlin. In southern Germany and notably in Saxony, where the percentage of working people in manufacturing districts is exceptionally large, the consumption of horseflesh is still greater, and is constantly increasing. The choicest cuts of horse meat sell in Berlin from fourpence to fivepence per pound. Meat from the forequarters or from any part of poor, old, or inferior horses sell as low as three halfpence and twopence. The liver, however, is considered a delicate morsel, and fetches fivepence a pound. The inferior pieces go into the mill for the manufacture of those strongly-spiced sausages flavoured with garlic that are the favourite food of many of the poorer classes in Germany. In the better grade of these sausages pork is mixed, to give the requisite fatness, and when sold for consumption in Berlin they must be plainly labelled "Pferdefleisch" (horseflesh). Outside the municipality this regulation is, however, not enforced, so that quantities of sausages made of horseflesh, with only a small per-centage of pork, veal, or other meat in their composition, are sold to the country districts or exported to the neighbouring countries as ordinary pork sausages. The American Consul adds that, apart from the very general sentiment of respect for the horse as an animal too noble and useful for the degradation of the slaughterhouse, there is perhaps no good reason why its flesh is not as clean and nutritious as that of horned cattle, and the fact of its far greater cheapness in a country where all meat is

so costly as it is in Germany, makes the well-regulated system of horseflesh preparation and supply in Berlin a real boon to a large class of people.

GENERAL NOTES.

IMPROVEMENTS IN THE INDIAN INDIGO INDUSTRY. — At Dalsingh Serai laboratory some experiments have been carried on by Messrs. Bloxam, Leake and Finlow, the report of which has been published. Unfortunately, great difficulties had to be overcome owing to the unfurnished state and limited accommodation of the laboratory, but the results are said to give promise of greater success in the future. Messrs. Bloxham and Finlow have discovered a method of isolating pure indigotin both cheaply and in large quantities from the crude material, so much so that it is proposed to work it commercially, although the efficiency of the process is not yet exactly determined. More important still, is the aid this discovery will possibly lend to further investigation of the indigo industry. The red colouring matter was also analysed, with a result that much of it was found to be present in both the artificial and plant indigo, but one was, it is thought, not the same as "indirubin." Indigo containing this red is of much higher value than that containing blue colouring matters only. Mr. Leake has tried to improve the indigo by a process of selection and has succeeded in so far as in certain experimental plots at Dalsingh Serai, the produce is as much as doubled since 1903. These laboratories are now under the Pusa Institute, and are used for the furtherance of everything affecting agriculture by original research. The results obtained under the old *régime* are favourable in themselves, but still greater successes may be expected when the Government undertake the work, and when the experimenters are not hampered by lack of means or accommodation.

MOTOR BOATS AND HERRING FISHING.—The question of auxiliary power to sailing vessels has become one of increasing importance. In the Shetland Islands, says Mr. Consul Villiers, in his report on the Faroe Islands for 1904 (No. 3404, Annual Series), it has been declared vitally important for the herring fishing. A benzine motor boat has been plying among the islands for some time, but petroleum motors are now chiefly attracting public attention. More than one fishing smack has already been satisfactorily supplied with a petroleum motor, giving a speed of six or seven knots. The first was a vessel of about 50 tons. Smacks are thus enabled to enter harbours promptly with their catch, and leave again at will for the fishing banks, without waiting for the chance of a favourable breeze and not too strong a current. A telegraphic cable is about to be laid from the Shetland Islands to Faroe and Iceland, and will be open for public service on October 1, 1906. Telegraphic communication will be of much service to British fishing companies since it is very important to them that their vessels should not be entirely isolated, especially in case of wreck or break-down, and the cable must materially assist in the development of the growing fishing industry. Prices will be quoted, and vessels will know when and where to sell their fish to the best advantage, instead of sailing vaguely hence as now.

PERSIAN GULF TRADE.—According to the German Consul at Bushire, the imports of Bander Abbas, on the Persian Gulf, in the fiscal year ended March 31, 1904, were valued at £340,000, and the exports were valued at £91,000. The imports consist chiefly of cotton textiles and yarns, sugar, tea, and metal wares, of which £120,000 worth were received from Great Britain, £127,000 worth were from the British East Indies, about £42,000 worth from France, and the remainder was furnished by Austria-Hungary, China, the Dutch Indies, Russia, Belgium, and Japan. Four-fifths of the exports go to British East Indies, and consist mainly of almonds, raisins, wool, opium, and Persian carpets. The trade is in the hands of Persian and Indian firms, and the imported goods go to South-Eastern Persia and Western Afghanistan.

COTTON GROWING IN EAST AFRICA.—The report of Messrs. Linton and Brand on the cultivation of cotton in East Africa does not point to early and extensive development of the industry in those regions. The settler intending to grow cotton cannot do with a smaller capital than £750. He must be able to train his own oxen, and willing to plough and do all other necessary work until natives are trained to it. Labour cannot be said to be dear, varying from 5s. 4d. to 13s. 4d. per mensem, but it is deficient both in quality and quantity. The obvious remedy is to bring tillage implements into more general use, but here two difficulties have to be faced —skilled labour is unobtainable to work the implements, and in certain districts cattle can scarcely exist. And when the master has produced his cotton he finds it difficult to get rid of it. "Just when farmers are beginning, and in most need of all possible facilities, it is unfortunate that no cotton market exists, and that transport, more particularly sea transport, is in an unsatisfactory state." The natives are beginning to grow cotton, but they are apathetic, and require constant supervision. The conclusion arrived at by Messrs. Linton and Brand is that "Until the labour question is solved, it would be dangerous for even the present settlers to count on cultivating more than a few hundred acres each, and, in short, the total area cropped under European supervision can scarcely exceed a few thousand acres."

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NOTICES.

CHAIRMANSHIP OF COUNCIL.

On Monday, 10th inst., at their first meeting, the Council elected Sir Owen Roberts, M.A., D.C.L., F.S.A., as Chairman for the ensuing year.

The various Committees were re-appointed.

COUNCIL.

At the last meeting of the Council, on Monday, 10th inst., Sir Philip Magnus was elected a Vice-President of the Society, in place of Mr. William Thomas Shaw, who is unable to accept the office.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Tuesday afternoon, 11th inst. Present: Sir George Birdwood, K.C.I.E., C.S.I., in the chair, Lewis Foreman Day, F.S.A., Gerald C. Horsley, A. Lasenby Liberty, Halsey Ricardo, and Sir Thomas Wardle, with Sir Henry Trueman Wood, Secretary of the Society, and Henry B. Wheatley, Secretary of the Section.

The arrangements for next session were considered.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Wednesday afternoon, 12th inst. Present:—Sir William Lee-Warner, K.C.S.I., in the chair, Sir Mancherjee Bhownaggree, K.C.I.E., M.P., Sir George Birdwood, K.C.I.E., C.S.I., F. C. Danvers, General J. Michael, C.S.I., Thomas H. Thornton, C.S.I., D.C.L., Sir Raymond West, K.C.I.E., LL.D., Arthur N. Wollaston, C.I.E., W. Martin Wood, with S. Digby, Secretary of the Section.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 5th July, too late for the results to be included in the Report of the Council. They lasted for 11 days.

The examination was conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 437 candidates entered, and of these 418 were examined, a decrease of 139 as compared with last year. There were 319 passes and 99 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and clarinet. 343 entered for the piano, 257 of whom passed; 55 entered for the violin, of whom 47 passed; 3 entered for the violoncello, all of whom passed; 14 entered for singing, of whom 9 passed; 2 entered and passed for the viola, and one for the clarinet. No medals were awarded.

The Examiners report that the chief causes of failure to secure a certificate were owing to the non-observance of good touch and tone, exaggerated accent, or inability to perform the music at the recognised pace. There were also some cases where the candidate showed inadequate knowledge of the minor scales, whilst others were quite unprepared with them. In several respects, indeed, there was evidence of want of care in reading the printed conditions.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

INTERNAL COMBUSTION ENGINES.

By Dugald Clerk, M.Inst.C.E.

Lecture II.—Delivered February 20th, 1905.

Syllabus.

Indicator Diagrams and Power Tests.—Diagrams from engines using coal gas, producer gas, blast furnace gas, petrol and heavy oils—Practical efficiencies and limitations in large and small motors for constant volume and constant pressure engines—Brake tests—Irregularities in diagrams, pre-ignitions, exhaust explosions, missed ignitions.

In considering the indicator diagrams obtained from actual engines, it is necessary to remember that the operations of the ideal engines which I have briefly discussed in my first lecture, are not followed in many respects. The actual engines differ from the ideal ones in many ways. Following the cycle of operations as it occurs in a constant volume engine:

(1) The working fluid generally gains some heat on entering the cylinder at a time when it would be better for the temperature to remain at its lowest point.

(2) During compression, the line followed is not quite adiabatic. There is a certain amount of heat loss going on to the sides of the cylinder after a certain part of the stroke is completed.

(3) The supply of heat is never added instantaneously as required in this type. Naturally the spread of the flame takes some time, although undoubtedly that time is very short. The time taken, however, depends upon many circumstances, some of which we shall consider.

(4) During the expansion stroke, after heat has been added, considerable heat loss occurs to enclosing walls and to the end of the piston.

(5) The working fluid does not behave as a perfect gas. Owing to the complex phenomena of combustion its physical state is changed to some extent during the addition of heat; that is, while we compress one working fluid, viz., a mixture of inflammable vapour and air, we expand another working fluid, viz., a mixture of nitrogen, some oxygen, and products of combustion.

(6) The admission, transfer and expulsion of the working fluid are not accomplished without some resistance—throttling during admission and back pressure during exhaust.

In discussing the effect of these necessary conditions of the practical engine, I propose to begin with the Otto or four-stroke cycle, following with the Clerk or two-stroke cycle, and concluding with constant pressure cycles, whether using four or two stroke mechanism.

In all these types, I shall follow the charge through the engine, dealing first with the charging stroke and its losses, then the explosion or ignition period, then expansion, and lastly, the exhaust period, discussing as we proceed the precautions necessary to secure the best results.

On the charging stroke the losses are of two kinds, both of which tend to reduce the charge weight admitted to the cylinder. The mechanical loss is due to throttling at admission, and the physical loss is due to heating of the charge as it enters the cylinder. It is the object of the engine designer to get the greatest possible weight of charge into the cylinder per stroke, so as to obtain the maximum power for given dimensions. Throttling during admission causes loss by resistance to the movement of the piston, but this loss is trifling. In a well-designed engine, it does not usually exceed from 1·5 to 2 lbs. per square inch. Such a loss is between 2 per cent. and 3 per cent. of the indicated power, and so far as resistance to engine movement is concerned, slight variations are of little importance. This point, however, requires careful attention for another reason: the effect of throttle on charge weight is very material. Assume atmospheric pressure to be 15 lbs. per square inch, then a deficit of 1·5 lbs. means reduction of charge weight by 10 per cent.; 3 lbs. reduction by 20 per cent. That is, in a given engine with certain permissible limits of maximum temperature, the power would be reduced by 10 per cent. by the first imperfect filling, and 20 per cent. by the second. It is therefore of great importance to secure the proper filling up of the cylinder to atmosphere at the out end of the stroke. This is secured in the best gas engines by holding the inlet valves open considerably after the crank crosses its out centre. In many engines running at fair piston speeds the inlet valve does not completely close till the crank has passed from 30° to 40° under the centre. As the cams of modern engines are all of the trailing type, so as to secure quiet seating, this results in the valve being well open at the end of the stroke, and practically closed before the piston returns materially.

To obtain the best result, it is necessary to keep the charge velocity through the inlet valve low and have the air and gas passages

as direct as possible. A very usual mean charge velocity is 80 feet per second. To secure this free charging, the inlet valve also opens before the termination of the exhaust stroke—30 per cent. is usual—and for another reason the exhaust and charging valves are often open together. The effect of throttling in reducing the power of the engine is the same as that found in engines working up among the mountains. Assuming barometric pressure at the sea level to be 30 inches of mercury, then at 3,000 feet up the pressure would be about 27 inches, so that the engine would lose 10 per cent. of its power. This loss is analogous to loss due to throttle.

So much for the mechanical loss. The heating loss acts in the same direction. Gas engines of moderate dimensions, say up to 18 inches cylinder diameter, are found to give maximum economy when the water jacket is somewhat warm, usually about 80° C. Working in this condition at nearly full load, the piston end gets somewhat hot, something like 400° C. in an engine of small dimensions; and in one so large as 20 inches diameter, something like 700° C., or a dull red in the dark. I am referring of course to ordinary pistons without water jacketing in the piston itself. The exhaust valve also heats to about 400°. When the charge, therefore, enters the cylinder the air and gas supply being at a temperature of, say, 17° C., it comes in contact with walls heated to 80° C., and a piston end and exhaust valve much hotter. This raises the temperature of the charge as it enters, so that when the cylinder is completely charged it is considerably hotter. It is difficult to determine this temperature, but it is very important to know it, not only from the point of view of loss of power, but also from that of pre-ignition. A comparatively small rise in charging temperature will readily produce dangerous pre-ignitions in large engines, and annoying ones in small. Measuring this charge temperature as best one can, it is found that 100° C. is not uncommon. Now a rise from 17° C. to 100° C. reduces the charge weight, and therefore the engine power, from 1·0 to 0·775; that is, it reduces the power by 22·5 per cent. Thus we see that for every degree Centigrade rise above 17° C., we lose power in the engine by 0·344 per cent.

From the point of view of power alone, it is accordingly very important to keep down the charge temperature, as a loss of 20 per cent. and more is easily incurred in this way. So far, the moral of all this is, if the maximum power is required from the engine, keep everything as cool as possible.

The cylinder has now been charged, and the piston is ready to compress the charge into the combustion space; and here new conditions arise. To get adiabatic compression, there should be the least possible temperature difference between the enclosed charge and the walls. Compressing in a very usual ratio to $\frac{1}{5}$ volume, as shown in several of these diagrams, the temperature would rise from 17° C.—without heat losses to about 300° C. The mean temperature of the walls is, of course, lower than this, so on the compression stroke heat losses occur. These would not be serious if the initial temperature had really been 17° C.; but with initial temperature of 100° C. the terminal temperature of adiabatic compression is very much greater; it would rise as high as 470° C. In this case, therefore, there is some loss to the walls. To minimise loss the walls should have approached the temperature more nearly, but that, of course, is impossible, and in this part of the process also the least loss would be found in keeping down wall temperature. Compression being completed, the inflammable mixture is ignited. The time of firing varies with the nature of the gas used; but the object is to make the heat addition as quickly as possible, without causing the pressure to rise so quickly as to produce shock in the engine. With a weak mixture the ignition must be begun early, while the crank is well under the centre, so as to complete the inflammation before the piston has time to make much forward movement. As a rule maximum temperature should be attained before the piston has performed more than $\frac{1}{70}$th of its forward stroke, otherwise the good effect of high compression is to some extent lost. It does not do to ignite too early, however, even to get maximum temperature at the very end of the stroke, as then the hottest flame is exposed for so long a period that the expansion curve falls to a lower point than would otherwise be the case.

The piston now proceeds on the expansion stroke, and the study of the expansion line is of great interest. It is generally stated that this expansion line follows a curve which can be expressed by the equation

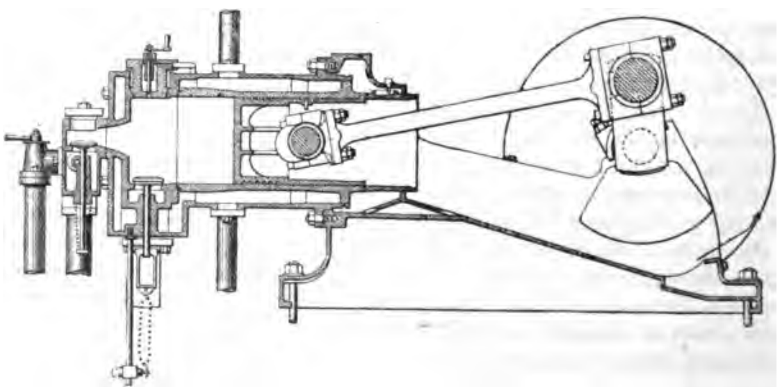
$$PV^k = \text{const.}$$

A close investigation of many of these curves, however, shows that this is by no means uniformly true. The expansion curve is in part

isothermal, and part no doubt can be expressed in this way; but different parts have varying values of *k*. It is very important to study this curve thoroughly. To do this, it is desirable to follow the temperature from point to point. To do this easily, I find it a good way to draw an isothermal line from the out end of the stroke, and then to measure the different temperatures in terms of the pressure values on that line, keeping in mind that at every point of the curve temperature is proportional to absolute pressure. When investigating a number of cards, it is convenient to have isothermal temperature scales made so as to read off temperature at each point of the diagram directly.

The interest of this expansion lies in the fact that further advance is to be found in but a variable specific heat does do this. And no doubt it is true that there is some variation of specific heat in the case of high temperature flames, such as those of the gaseous or vapour explosion. Carbonic acid gas cannot be far from its dissociating point, and no doubt specific heat increases to some extent because of that. This appears to be proved by Professor Harold Dixon's experiments. Steam also may be near its dissociation point, although not so near as CO_2. This, however, by no means accounts for all the phenomena of heat suppression, because at low temperatures there is as great a heat suppression as at high; and this of course could not be so if increasing specific heat furnished the whole explanation. All are agreed on two things, then: that heat is

FIG. 10.



VERTICAL SECTION OF NATIONAL GAS ENGINE.
Type "X." Diameter of cylinder 14"; stroke 22"; B.H.P. 68.

understanding its message fully; and a very difficult study we find it. One fact, however, emerges clearly: that is, heat is added during the expansion stroke. On this the rival theories are at one. It does not matter whether we adopt the varying specific heat theory, or continued combustion theory, both agree that heat is added. I have observed that many engineers imagine that increasing specific heat at high temperatures does away with the idea of heat additions, because the expanding line becomes an adiabatic, with varying specific heat. But the idea of an adiabatic line with varying specific heat is only another way of saying that the gas is not a perfect gas, but is a substance capable of rendering heat latent, and giving it up again, just like the case of water and steam. A higher constant specific heat does not imply the idea of heat evolution, or absorption; added in the expansion curve, as well as on the rising temperature curve. They differ on the explanation, but all admit the fact.

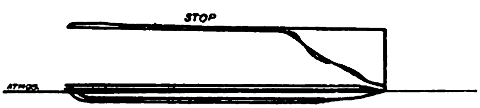
The cycle is completed by the opening of the exhaust valve, and the expulsion of the products of combustion. This should of course be done with as little resistance as possible. Mean velocity of exhaust in a good engine will be about 70 feet per second. To furnish the data required for the careful study of a diagram, it is necessary to determine the following principal quantities, in addition to taking diagrams:—Brake power, indicated power, gas consumption, air consumption, heat flow through jacket, radiation from engine, heat carried away by exhaust gases, heat value of gas, engine dimensions, clearance space.

I will now consider diagrams taken by myself in tests recently made with a National

gas engine, called by the National Company "X" type, having a cylinder diameter of 14 inches, and a stroke of 22 inches. The engine is shown in the section, Fig. 10. I have taken this engine for the purpose of explanation, because the clearance spaces have been accurately determined, and all the dimensions of the engine and particulars are fully before me. In many cases it is impossible to extract all the information which diagrams can give for lack of knowledge of such data as clearance space, and probable temperature of engine jacket.

Fig. 11 is a light spring card from the

FIG. 11.



LIGHT SPRING CARD FROM NATIONAL GAS ENGINE.

engine, to show the resistance to charge and discharge. In all engine tests, these light spring cards are taken with a spring having a strength of about 10 lbs. to the inch upon the diagram. They are necessary, as it is otherwise impossible to distinguish clearly what is going on when a heavy spring is in the indicator for the purpose of taking explosion and expansion pressures. From this diagram you will see that the piston on its forward stroke draws in a charge which reduces the pressure to about 1½ lbs. below atmosphere. This is a resistance. At the end of a stroke the cylinder fills up while the piston is crossing the centre, and the cylinder is thus nearly fully charged with a mixture of gas and air. This filling up of the cylinder is very important, as a very small defect of pressure at the charging end of the stroke greatly reduces the power of the engine. All the good engine designers hold open the charging valve while the crank is crossing the centre at the out end of the stroke, so as to enable the pressure to rise as nearly as possible to atmosphere before compression begins. It is accordingly very important, when inspecting a light spring card, to note whether the cylinder is well filled or not. The object of the designer is to cause the cylinder to fill entirely up to atmospheric pressure before the piston returns on its compressing stroke. The light spring card also shows a line above the atmospheric line, the higher pressure being due to the resistance of the exhaust gases. The mean back pressure from this cause is something like 2 lbs. on the square inch. It is an interesting fact that when an engine is governing in the commonest English method—that is, by cutting out impulses—the discharge stroke of the cold air always shows a greater back pressure than that of the hot exhaust. This is due in part to the heavier weight which must be moved by the piston, when the gas to be discharged is cold, and in part to the fact that a vacuum wave is caused in the exhaust pipe of a gas engine by the act of discharging the exhaust from a pressure above atmosphere. So far as the light spring card is concerned, the two main points to be noted are the resistance on the suction stroke, and the terminal pressure before compression. Further, the freedom of the exhaust discharge is also to be noted, although that may vary to a greater extent than the charging resistance, without causing serious loss in the operation of the engine. So much for the light spring card.

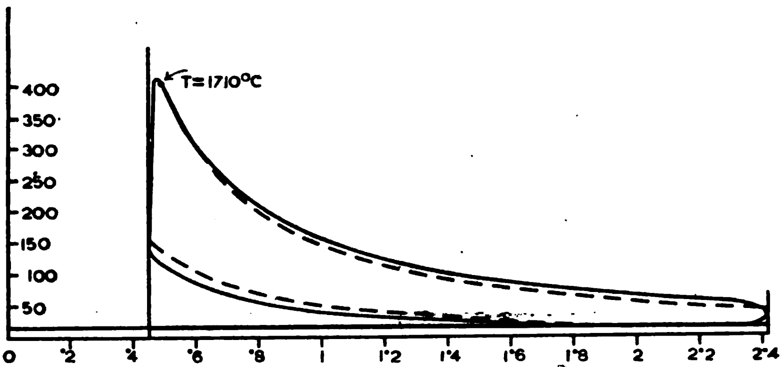
Fig. 12 shows an indicator card taken with a heavy spring. In it is seen a slightly thickened line, about the atmospheric line. This is all that is shown of the suction and exhaust resistance, because of the very powerful spring necessary to resist the explosion pressure. This card is used to follow the compression, the ignition, the expansion, and the first part of the exhaust—that which falls from the terminal expansion pressure to the atmosphere.

Looking at this card, in the light of experience of many diagrams, it becomes obvious that the mixture here has been slightly too strong. The result is distinctly economical, but it is not so economical as the result with a slightly weaker charge. I have marked under the diagram the various particulars of the test made at the time at which the diagram was taken. Upon this diagram I have shown the clearance space of the engine, and I have calculated and plotted upon the diagram the adiabatic expansion line from the point of minimum temperature. I have also dotted above the main compression line the adiabatic line which would be followed if no heat loss occurred during compression. From these dotted lines you will see that whereas the compression line falls slightly under the adiabatic the expansion line keeps somewhat above it.

Taking this card, and calculating the heat evolved, the heat accounted for at the point of maximum temperature, I find that altogether some 70 per cent. of the total heat of com-

bustion appears to have been evolved at that point; or, putting it in accordance with the idea of the French physicists, the specific heat of the charge has increased at the high temperatures, and so, although the whole heat is evolved, it cannot produce the effect in increasing the pressure which would be produced had specific heat remained constant. The temperatures at the principal points are given below the diagram; and here it is necessary to explain that some difficulty arises in calculating these temperatures. This difficulty is one which does not depend upon the question of combustion or no combustion, but is a purely experimental one. As you are aware, in order to calculate the temperatures on every already said, is somewhere in the neighbourhood of 80° C., that is, the water jacket, which is seen in Fig. 10, for keeping the cylinder and combustion space cool, is best so arranged that the cylinder is maintained at this temperature. Under these circumstances, in such an engine as this, the piston end of course attains a much higher temperature, and it becomes difficult to estimate what is the exact temperature of the charge as it enters. Assume the air and gas to be entering at atmospheric pressure and temperature, say 17°C., then it is obvious that the charge becomes heated as it passes into the cylinder. The entering gases impinge upon the hot walls upon the hot piston, and so they become heated. They

FIG. 12.



HEAVY SPRING CARD FROM NATIONAL GAS ENGINE.

Rich mixture; mean pressure 94·5 lbs. per sq. in., 57·5 B.H.P.; maximum temperature, 1,710° C.; exhaust temperature, 1,000° C.; temperature of compression, 440° C.; temperature of charge before compression = 90° C.; indicated efficiency, 33 p.c.; dotted lines adiabatics through points of maximum and minimum temperature, $\gamma = 1·408$.

part of this diagram, it is necessary to know the temperature at some one point with some accuracy, or to know the total weight of charge contained within the cylinder just before compression commences. In ordinary tests it is difficult to determine the volume of air taken into the engine, and all that we usually know is the volume of gas used for a given number of strokes, and the volume swept by the piston during its operations. If we knew the weight of charge entering the engine, including the weight of the exhaust gases remaining in the combustion space at the exhaust end of the stroke, then all the temperatures on this diagram could be calculated with ease and certainty.

In the ordinary running of an engine of this type, at anything like full load, it is found that the best water jacket temperature, as I have also become heated to some extent by mixing with the exhaust gases remaining from the previous explosion, in the combustion space of the engine. The question of the heat given by these exhaust gases, and the heat given to the walls, is one which it is necessary to solve in order to know the exact temperature of the incoming charge. In these particular experiments, the air supplying the engine was measured. This determination enables me to give not only the volume of air and gas admitted to the cylinder, but also the volume of air. The only question remaining, therefore, is the weight of the exhaust gas left. This has been determined by several experimenters, and recently the question has been carefully gone into by the Thermodynamic Standard Committee of the Institution of Civil Engineers, of which I have the honour to be a

member. This question has been very carefully considered by that committee, and we hope soon to be able to give some definite results of our labours on this, among many other points. Meantime I may say that the charge temperature on this diagram, determined as nearly as possible, amounts to 90°C. Assuming then this to be the temperature of the charge before compression, the temperature in the different parts of the diagram have been calculated by well-known formulæ. Comparing these figures with those on the ideal card for the same clearance, it appears that the expansion curve shown here is somewhat above the adiabatic. This of course means that in some way heat has been added on the expansion stroke, either by change of specific heat or by continued combustion, so as to make up for the loss passing through the cylinder sides. In this particular test the heat distribution is approximately as follows:—

Indicated work	33·1	57·5 B.H.P.
Jacket loss	36·0	
Radiation	6·0	
Exhaust loss	42·0	
	107·1	

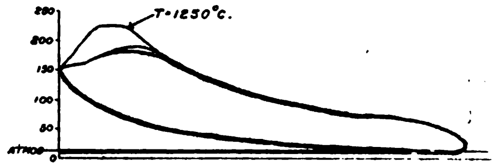
This method of determining the disposition of the heat should always overbalance. The reason for this is that part of the heat set down as exhaust loss does not really get away from the engine. The hot exhaust gases impinge on the surfaces of the valve boxes and exhaust passage, and thus give up part of their heat to the engine and water jacket. This heat is thus taken into account, both under the head of jacket loss and as exhaust loss. Part of the loss set down as exhaust loss is also given back to the engine as heat given to the incoming gases.

Here we have a very good efficiency, 33 per cent. for the indicator and 28 per cent. for the brake; but this is not the best result which the engine can give.

The efficiency may be improved by slightly throttling the gas so as to give a smaller gas supply. The ignition would then take a longer time, and the upper part of the explosion curve on the diagram would be gently rounded, the maximum temperature being considerably and the mean pressure slightly reduced. An indicated efficiency of 35 per cent. may thus be obtained with this engine.

Fig. 13 shows another card, or series of cards, where the dilution has been carried to an extreme. The effect here is to cause the engine to run, not quite but almost as a constant pressure engine. Considerable reductions in maximum temperature and mean pressure, however, are noted; but as you will see, the economy falls off considerably. It is 25 per cent. Bk. E. and 29 per cent. I.E. Here the consumption has risen from the best point, which is slightly less than that shown in Fig. 12, to about 18 cubic feet per B.H.P.

FIG. 13.



HEAVY SPRING CARD FROM NATIONAL GAS ENGINE.

Very weak mixture; maximum temperature 1250° C.; mean pressure 85 lbs. per sq. in.; indicated efficiency 29 per cent.

per hour, and the power has fallen by more than a third, to 38 B.H.P. These diagrams illustrate the range within which economy may be found. The first diagram corresponds to some extent to what in the steam engine would be known as an overload diagram; slightly less gas would give a diagram of maximum economy; and the diagram (Fig. 13) shows a case where the mixture has been purposely over-diluted. Although the ignition is too late, and consequently the cycle becomes rather a constant pressure than a constant volume cycle, yet the absolute heat loss through the sides of the cylinder is considerably reduced, the relative loss remaining about the same.

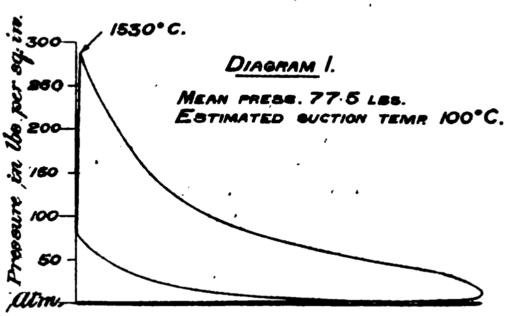
Comparing the efficiencies obtained with a normal gas supply with the standard air engine efficiency given for the same clearance space in the last lecture, you see that the efficiency in the actual cycle ranges from ·6 to ·7 of the ideal. These diagrams are taken with coal gas, and at the time the test was made Junkers's calorimeter was used to determine the heating power of the gas. Measurements have also been taken of air temperature, barometric pressure, and so forth—a sufficient number to give approximately accurate results.

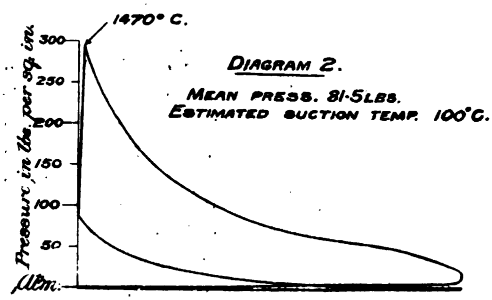
Figs. 14, 15, 16, 17, 18, and 19 show a number of diagrams taken from various engines with different gases,—coal gas, producer gas, blast furnace gas, petrol, and heavy oils. The engines are all standard ones—

Crossley, National, Stockport, Premier, and Richardson Westgarth's Cockerill. I have marked under each diagram the main particulars, so far as I have been able to calculate them from the data furnished to me; and comparing the diagrams you will see that generally the coal gas explosions show fairly sharp rises, as in the Crossley and National engines, while the producer gas explosions generally, though not always, show a gentler rise, and a more indefinite maximum point. Many makers use somewhat higher compressions for producer gas than for coal gas, and when blast furnace gas is used, still higher compressions are adopted. This you can see by looking at Fig. 16, where the compression pressure has risen to nearly 150 lbs. in one case.

The petrol engine diagrams (*see* Fig. 17) were taken by Professor Callender with a very small air-cooled bicycle motor. The revolutions and various particulars are marked under the diagrams.

Fig. 14.





Diagrams 1 and 2 from Crossley Two-cylinder Engine.

Cylinders, $18\frac{1}{2}$ in. diameter by 30 in. stroke; average speed 172 revs. per min.; indicated h.p. 273; brake h.p. 253; indicated thermal efficiency 30·3 per cent.; test made with Manchester Corporation coal gas, 607·5 B.T.U. per cub. ft., lower heat value. Particulars handed to author by W. J. Crossley, Esq.

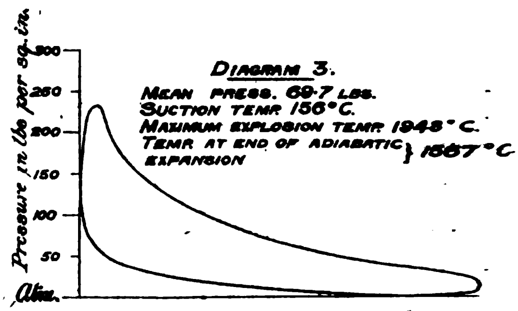


Diagram 3 from Professor Burstall's Second Report to the Inst. M.E.; B trials, Test 1.

Engine cylinder, 6 in. diameter by 12 in. stroke; speed about 200 revs. per min.; indicated thermal efficiency 19 per cent.

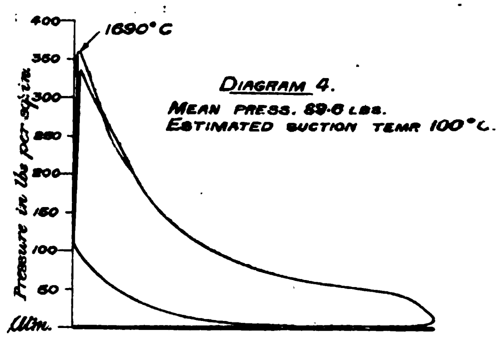


Diagram 4 from National Gas Engine tested by Professor Robinson.

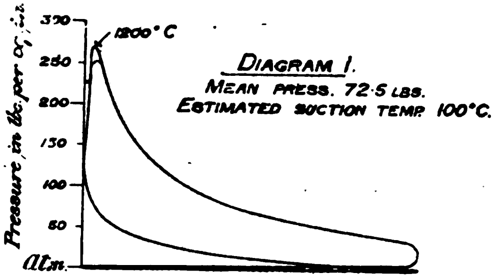
Cylinder, 10 in. diameter by 18 in. stroke; average speed 170·3 revs. per min.; indicated h.p. 26·4; brake h.p. 23; indicated thermal efficiency 28·7 per cent.

Fig. 18 shows diagrams from the well-known Hornsby engine, taken by Professor Robinson; and Fig. 19, similar diagrams from a heavy oil engine by the National Gas Engine Co.

Looking at these diagrams, you will notice that very varying compressions are used, and that the appearance of the diagrams vary to a considerable extent. In all these engines, however, you will find that if the compression space be known, and the efficiency be calculated from the formulæ for constant volume engines using air without heat losses, and that efficiency multiplied by a factor between ·6 and ·7, the practical efficiency of the engine will be at once given.

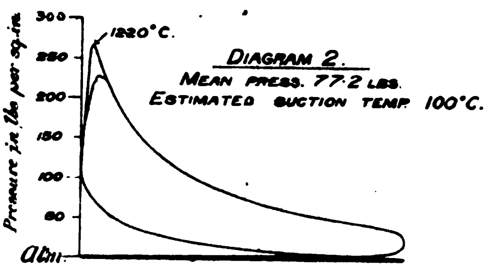
On the adiabatic compression curve shown in Figs. 5 and 6 I have marked temperature and degrees Centigrade at various stages of compression. A consideration of these temperatures will make evident the reason for

FIG. 15.



STOCKPORT ENGINE.

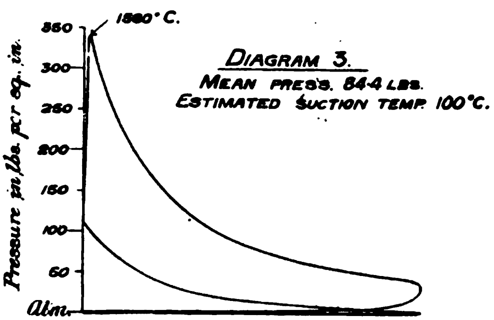
Cylinder, 20 in. diameter by 27 in. stroke; speed, 182 revs. per min.; indicated, h.p. 141; at Musker and Co.'s, Liverpool, using Wilson producer gas.



STOCKPORT ENGINE.

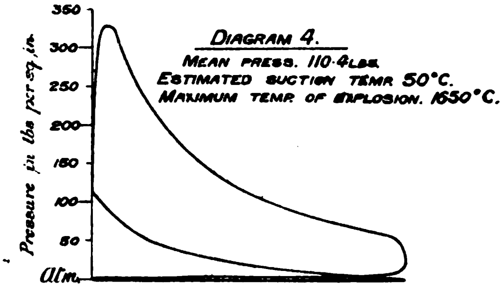
Cylinder, 18 in. diameter by 27 in. stroke; average speed, 180; indicated, h.p. 113; at Musker and Co., Ltd., Liverpool, using Wilson producer gas.

Diagrams 1 and 2 and particulars of test have been supplied to the author by Messrs. J. E. Andrew and Co., Ltd.



NATIONAL GAS ENGINE.

Brake, 40. h.p.; speed, 170 revs. per min., giving brake 32 h.p. at time of test; four explosions and one cut-out; engine at work at Dowson's Works, Basingstoke, with Dowson suction gas plant using anthracite. Diagram taken by the author.



PREMIER GAS ENGINE AT WINNINGTON (TWO CYLINDERS).

Cylinders, 28⅛ in. diameter by 30 in. stroke; air scavenging cylinder, 43¼ in. diameter; average speed, 128 revs. per min.; working with Mond gas; pistons and exhaust valves watered. Diagram taken from engine by Mr. Humphrey in author's presence.

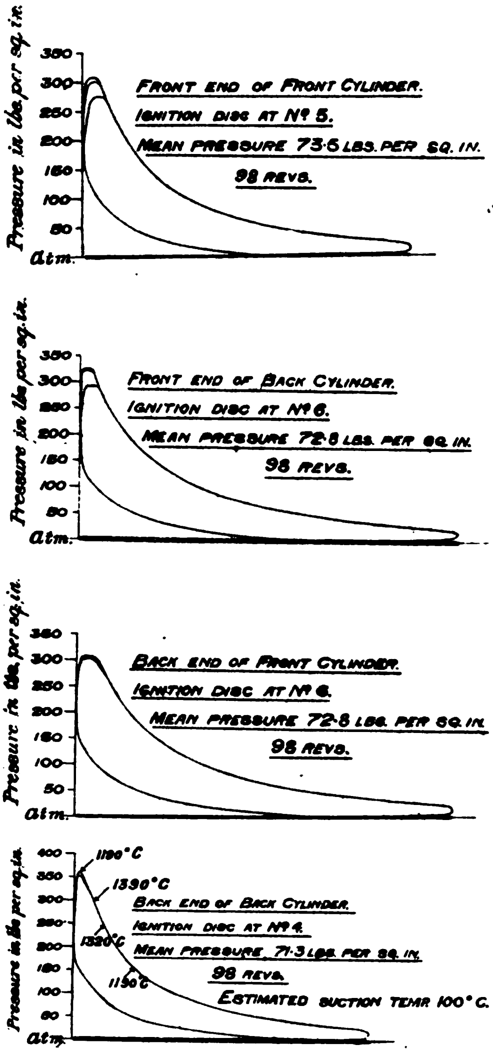
certain limits to increasing efficiency by increasing the compression. Mixtures of inflammable gas and vapour with air ignite at various temperatures, that is, once a certain temperature is exceeded, the mixture ignites. This igniting point is not very well defined, as a very slow combustion appears to take place in dilute mixtures at quite low temperatures. This has been proved by the investigation of both English and Continental chemists.

Many experiments have been made showing that, with certain mixtures of inflammable gases with oxygen or air, exposure may be made to certain temperatures without ignition; but when these temperatures are slightly exceeded the mixtures begin to ignite.

Looking at the adiabatic compression curve shown in Fig. 5 it will be seen that the temperature rises from 17° C., until at the pressure of 500 lbs. per square inch it reaches something like 600° C. This assumes that the charge before compression is at a temperature of 17° C. If, however, as is the case in the gas-engine cylinder, the temperature be nearly 100° C., then the temperature with compression to 500 lbs. is very materially increased. It is increased, in fact, in the ratio between the two initial absolute temperatures. With a Diesel oil engine running at full load, compressing to 500 lbs. on the square inch, the temperature will readily rise to something like 800° C. This is a fair red heat, and this temperature would ignite any inflammable mixture of gas and air.

The problem present to the designer of a constant volume engine is to get as high compression as possible, without exceeding the temperature of ignition of the particular

FIG. 16.



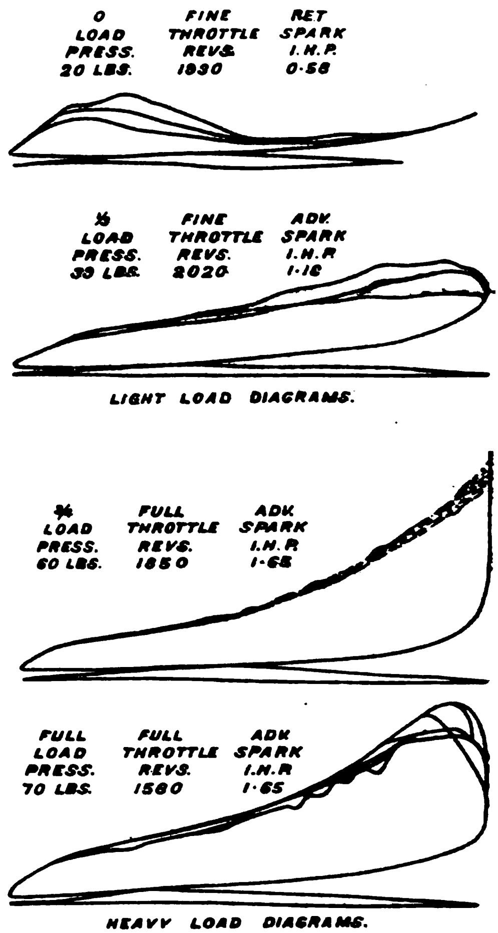
GAS ENGINE (COCHRANE, No. 250).

Cylinders, $29\frac{1}{4}$ in. diameter by $35\frac{1}{2}$ in. stroke; piston rods, $7\frac{2}{5}$ in. diameter; mean M.P. of 4 cards—72·6 lbs.; total I.H.P. at 98 revs.—810; indicator diagrams taken on July 15th, 1904, with temporary load on dynamo. Diagrams handed to author by Mr. Westgarth.

mixture of inflammable gas and vapour to be used in the engine. Although accurate figures have not yet been obtained, yet it is known in a general way that gases which contain a large proportion of hydrogen are ignited at a comparatively low temperature. With such gases it is accordingly necessary to keep down the compression, if premature ignitions or pre-ignitions are to be avoided. In ordinary practice, with coal gas and air, it is found, for example, that it is unsafe greatly to exceed a compression of one-fifth. If this ratio be exceeded, then any trifling circumstance, such as a spongy place in the piston or combustion space surface, or any little projecting part which can become unduly hot, at once causes frequent pre-ignitions. Pre-ignitions, in fact, are the limiting circumstance which prevents the highest compressions being used in motors of this type.

At Fig. 20 I have an indicator card showing a pre-ignition obtained in this engine, due to a spongy part in a tube carrying the indicator. These pre-ignitions, of course, at once reduce the economy of the engine, because they reduce the area of the diagram, and if pre-ignition becomes at all pronounced, the power

FIG. 17.



DIAGRAMS FROM PETROL ENGINE, TAKEN BY PROF. CALLENDAR.

FIG. 18.

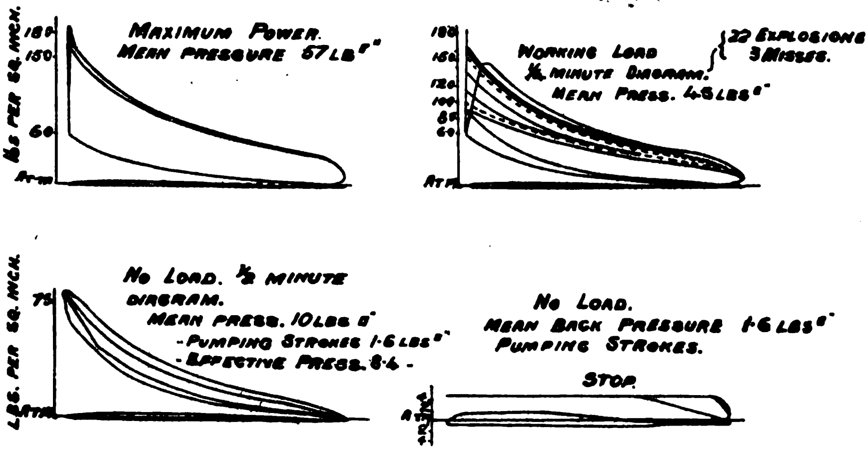


DIAGRAM FROM 25 H.P. HORNSBY HEAVY OIL ENGINE, 1898. TAKEN BY PROF. ROBINSON.

FIG. 19.

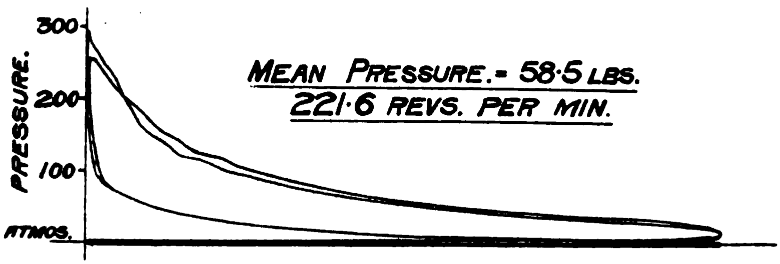
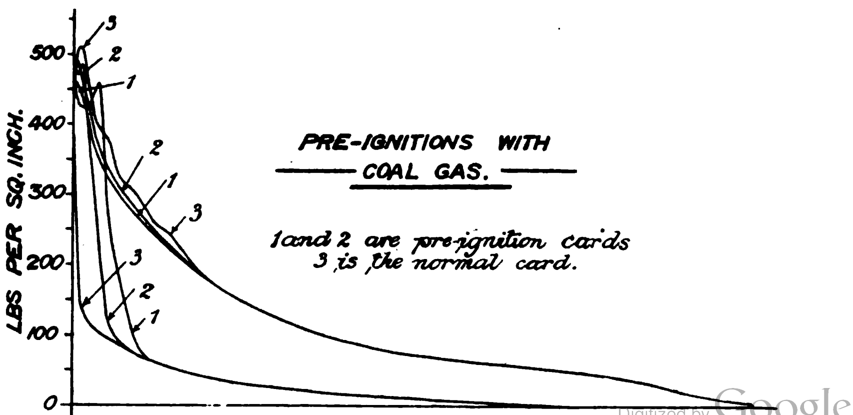


DIAGRAM FROM NATIONAL HEAVY OIL ENGINE. Oil Consumption ·736 lbs. per B.H.P. hour

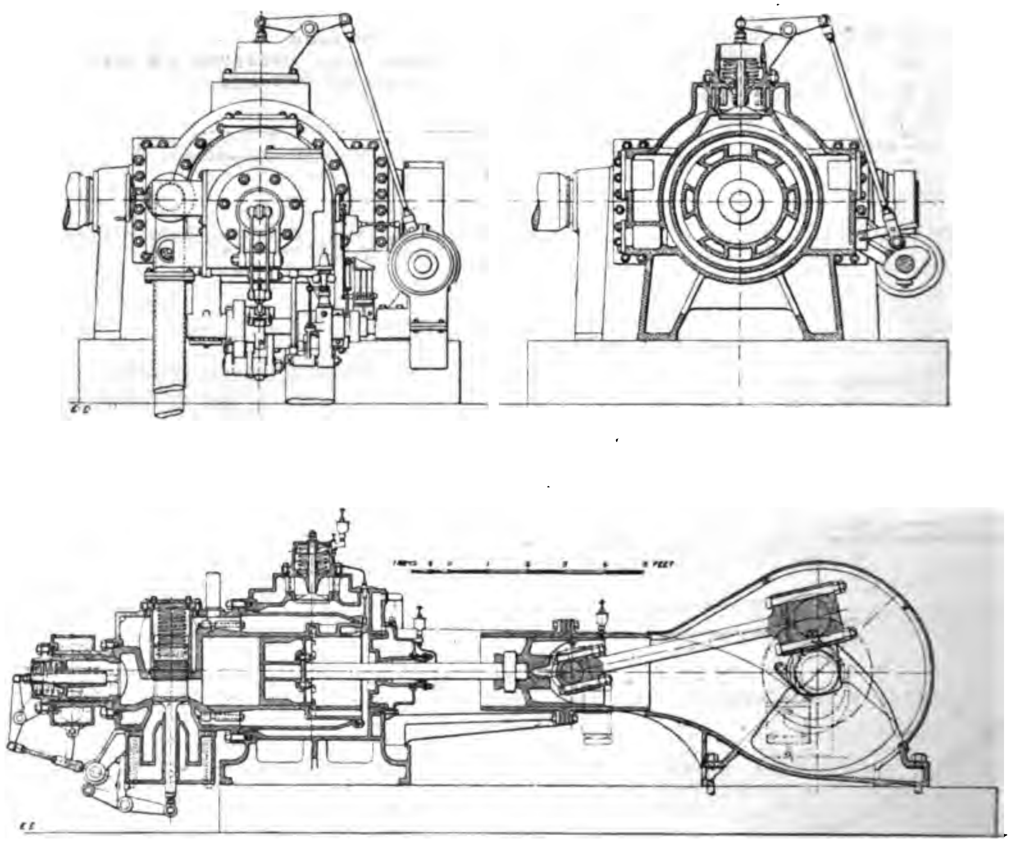
FIG. 20.



falls off with great rapidity. Engines have therefore to be designed to avoid pre-ignition. It has been found, for example, that heavy oil does not stand so much compression as a light oil—that is, a heavy oil, partly because of greater chemical activity, and partly because of the necessity of heating the charge to vaporise it, requires to be operated at lower compression pressure than a gas and air charge, where the charge is relatively cool.

All engineers engaged on gas engine work have to face this difficulty, and various solutions have been advocated. Generally it may be taken that the cooler the incoming charge, the piston, the cylinder, and the combustion chamber can be kept, the less liability is there to pre-ignition. Accordingly, in large gas engines which would otherwise pre-ignite readily, circulating water is very freely used, and the cylinders are kept much cooler than is found to

FIG. 21.



NATIONAL AIR COMPRESSION ENGINE.

give the maximum economy in smaller engines.

This will be seen on looking at the diagrams from the Hornsby and the National heavy oil engines. The great limiting cause in constant volume engines is really the danger of igniting the inflammable charge during the compression stroke; and this trouble becomes more pronounced with large gas engines. On the other hand, most very large gas engines use blast furnace gas, and this gas consists largely of carbonic oxide, with, as a rule, but little hydrogen. Consequently, it can stand a high compression without premature ignition.

In work in which I have recently been engaged at the National Gas Engine Co., I have designed two types of engine which are intended to meet this difficulty. One of these types, the air super-compression engine (shown at Fig. 21); the other, an exhaust super-compression engine, I have no figure here for, as it is still in the experimental stage. By air super-compression and exhaust super-compression, I mean the addition of air or cold exhaust charge under pressure to the engine

charge, and then the compression of the united diluted charge. This addition enables one to get high average pressures with low average temperatures. I have, however, already discussed engines of this type in the James Forrest lecture of last year, and in a paper read before the British Association in August last, so I need not deal with it here. The exhaust and air super-compression seem to me to enable us greatly to improve the performance of these engines by working with a motive fluid which is, on the whole, cooler than that given by an ordinary explosion. In my experiments I work at a maximum temperature of not more than 1,200° C., as against the usual maximum temperature of something like 1,600° C. or 1,700° C. Many engines, however, work at fairly low temperatures, such as 1200° C., as you see from the diagrams given of the Stockport engine here; but in such engines the mean pressure is lower than it would have been if some device such as exhaust or air super-compression had been used. The mean pressure indeed is lower by about 20 per cent. than it would have been. Another mode of overcoming this difficulty consists in injection of water into the cylinder during the compression stroke. This I understand is being used by Messrs. Crossley in accordance with a device of Banki, a Continental engineer.

Whatever device be used, when high compressions are required, it is necessary to look thoroughly to the cooling of every part of the engine, and to the admission of the working fluid at as low a temperature as is possible.

Although the pre-ignition is the greatest of the internal combustion motor difficulties in large engines, there are other troubles which occasionally give considerable annoyance. Sometimes an engine will ignite into the supply pipe. This is called a back ignition. This back ignition is due to the inflammation of the charge as it enters the cylinder by something which it encounters within the cylinder. Sometimes this something is found in the lingering flame from the previous explosion. This is always the case with diagrams like Fig. 13. In these diagrams the combustion rate is so slow that burning charge is still found in the cylinder, even on the beginning of the next suction stroke. The back ignition, however, may also be due occasionally to some incandescent matter within the cylinder, such as burning oil. It may be produced, for instance, by over-lubrication.

Another source of annoyance occasionally found is due to exhaust explosions. An exhaust explosion is caused by the missing of the ignition of the engine and the discharge of an unburned charge into the exhaust pipe and chamber. On the next ignition stroke the flame discharge through the exhaust valve sometimes ignites the accumulation which has passed into the exhaust pipes, and we hear heavy banging, as it is called. These troubles, however—back ignitions, exhaust explosions, and missed ignitions, are matters of little moment, compared to the pre-ignitions. They are now well under control. All good gas engines kept in reasonably good order entirely avoid them. All these troubles come in the main from over-heating.

It has often occurred to inventors to avoid all back ignition and other ordinary gas engine troubles by compressing air alone, and adding the inflammable charge just at the moment of completed compression. If this be done, there can of course be no pre-ignition. Pure air cannot ignite, however highly it may be compressed.

In 1887 I had an engine built on this principle, and Fig. 22 is a diagram taken from

Fig. 22.

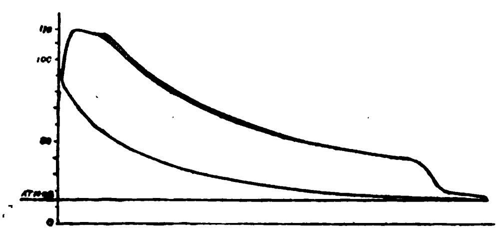


Diagram from Clerk Flame Engine, 1887.

it. This engine used ordinary coal gas, air alone was compressed in the cylinder, the gas was compressed separately by a side pump forced into the engine cylinder through a series of gas jets, and ignited exactly as it entered. This engine worked very well, but the mean pressures obtained were too low.

Herr Diesel took up the same idea somewhat later, and he endeavoured to apply it to both gas and oil engines. His attempts to apply it to gas engines have so far failed; but he has made a fair success in applying it to the oil engine. The difficulties, however, are very great. Diesel at first thought that he could produce an engine following the Carnot cycle. Ultimately he produced an engine of the constant pressure type, the theory of which follows the diagram shown at Fig. 3.

AGRICULTURAL AND INDUSTRIAL SETTLEMENTS.

The Rhodes Trustees having asked Mr. Secretary Lyttelton to nominate a Commission to proceed to the United States to inspect and report upon the condition and character of the agricultural and industrial settlements which have been established there by the Salvation Army, with a view to the transmigration of suitable persons from the great cities of the United States to the land, and the formation of agricultural communities, the Secretary of State for the Colonies nominated Mr. Rider Haggard, who left for New York at the end of February, and reported on May 5. It appeared to Mr. Lyttelton that if the Salvation Army experiments were found to be successful, "some analogous system might, with great advantage, be applied in transferring the urban populations of the United Kingdom to different parts of the British Empire." Accordingly, Mr. Haggard visited the Salvation Army Land Colonies situated respectively at Fort Romie, California, Fort Amity, Colorado, and Fort Herrick, Ohio. From the United States, Mr. Haggard proceeded to Canada, and, after consultation with the Dominion authorities, proposed a scheme of land settlement to Sir Wilfrid Laurier, by whom it was favourably received. Mr. Haggard asked the Dominion Government for a free grant of land suitable for settlement, and the Dominion Government has offered an area equal to ten townships, or 240,000 acres, say 360 square miles, with a promise of extra land to be given, if necessary, in the future. This area, allowing 160 acres per family, which is the ordinary Canadian homestead lot, would accommodate about 1,500 families, or, if an average of five persons is reckoned per family, 7,500 souls. The cost of the transportation, and the settling of that number of people in Canada, where the land is given, Mr. Haggard puts down roughly at £200 per family, or £300,000 in all. Mr. Haggard sought an expression of the willingness of the Canadian Government to assist in guaranteeing the interest on a loan which would provide the capital necessary to put the settlement scheme into operation, but this guarantee was not obtainable.

Mr. Haggard's inspection of the Salvation Army colonies has satisfied him that they have been "eminently successful," and that they warrant the belief that the congestion of our cities may be relieved, at any rate to some extent, "by exporting from them those who are physically, mentally, and in other ways suitable, and who are found to have fallen into or to be threatened with poverty, or who, being weary of towns, desire to attempt the adventure of a different life in new homes upon the land." But Mr. Haggard says that if the experiment is to succeed the colonists must be supervised, and he would entrust this work to the Salvation Army. "This vast organisation is, I am authorised to say upon its behalf, able and willing to make the selection of suitable settlers to any extent from among the poor of the cities of Great Britain, conducting their operations under the authority and direction of an Imperial officer, appointed, as I have suggested, to control them." As to the capital necessary to give the colonists a fair start, Mr. Haggard looks to the Imperial Government to provide the necessary guarantee, and he suggests that, "when this question of a guarantee comes up for discussion, it will be well worthy of consideration as to whether the large municipalities of the United Kingdom should not be asked in what shape they would be prepared to assist the movement so far as the law allows, or by emendation can be made to allow." Given sufficient capital, careful selection of the settlers and of the land, and skilled and sympathetic management of both after settlement, Mr. Haggard is confident that the suggested land colonies would be a success, an opinion from which probably few would dissent.

FACTORIES IN BRITISH INDIA IN 1902.

The latest return of Judicial and Administrative Statistics for British India,* compiled under the supervision of the Director-General of Statistics, deals with a variety of matters, such as criminal and civil justice, prisons, police, education, birth and death rates, lunacy, municipal activities and factories. Compared with the factory returns issued in New Zealand, the Indian statistics are lacking in several interesting particulars, such as capital outlay, value of raw material used, wages paid, and output, but give information of the order usually secured by inspectors of factories.

In addition to 84 factories owned by the State, or by local authorities, there are 1,389 undertakings worked by steam, and owned by companies or individuals. The former group covers 14 printing presses, 13 railway workshops, 11 canal and engineering workshops, together with a number of military arsenals and factories. The latter group contains 173 cotton mills, 39 jute mills, 67 cotton presses, 78 jute presses, 39 ironworks and foundries, 98 rice mills, and 64 saw mills. The cotton factories are located mainly in the Bombay Presidency, jute mills and presses in Bengal, while the rice mills and saw mills are mainly concerned with the exploitation of the two principal products of Burma—rice and teakwood. The average number of *employés* in 1902 consisted of 424,375 adult males, 85,882 adult females, 26,440 male children, and 4,937 female children. Of this total, 205,152 (or 38 per cent.) are employed in factories in Bengal, and 180,224 (or 33 per cent.) in Bombay, near three-fourths of the factory labour in India being employed in these two provinces.

The increase in factories seems fairly continuous, the number of adult males and other workers employed being as follows:—

* Published by the Office of the Superintendent of Government Printing, Calcutta, 1904, price 3s.

	Adult Males.	Women and Children.
1900	372,617	76,339
1901	408,950	104,266
1902	424,375	115,259

The number of accidents reported amounted to 3,107, of which 95 were fatal. Of these 37 occurred in Bombay and 33 in Bengal. Of serious accidents 194 occurred in Bengal, 102 in Burma, and 71 in Bombay. The largest number of minor accidents—1,491 out of a total of 2,517 occurred in Bombay. As regards offences against the Factory Acts, 24 convictions were secured, of which 7 were for the employment of persons in contravention of the Act, 6 for neglect of ventilation and cleanliness, 4 for neglect to send notices or returns, 3 for neglect to fence machinery, 3 for neglect to keep the prescribed register of children. and one for corrupt use of statistics.

THE TRADE AND INDUSTRIES OF NORWAY.

The long coast-line of Norway has always enabled her inhabitants to carry on a considerable trade with other countries, and, owing to improved communications, the exports of the country have rapidly increased both to European and Transatlantic markets. Experience has proved that Norwegian goods can hold their own in the world's markets, and, with the natural resources of the country, there is every reason to assume that the development will continue. According to a report just issued by the Trade Intelligence Bureau of Norway, the forests of that country form the basis of her high-class wooden articles, wood pulp, and paper industries; the utilisation of the immense quantities of fish contained in her seas also plays a very important part in the economy of the country. Agriculture has undergone a steady development, which has found expression in the export figures, and the vast sources of power of which the country is possessed in her waterfalls will give her industry a strong support on the markets of the world. Of the vast area of the country, 21 per cent. is covered with forests, and it is therefore natural that Norway should play an important part in supplying the world with timber. About 70,000,000 cubic feet of timber are exported annually. In addition, considerable quantities of wooden wares, such as joinery, cooper's wares, mouldings, &c., are exported. The export of Norwegian matches amounts to about 3,000 tons per annum. Special mention should be made of mechanical and chemical wood pulp, for which articles Norway is one of the chief centres of production. In 1904, Norway exported about 450,000 tons of her production of wood pulp to countries in, and beyond, Europe. The production of paper, chiefly printing paper, packing paper, and cardboard, is also of some importance. In 1904, the exportation of paper amounted to about 60,000 tons. The important coast fisheries yield the chief part of the fish products exported. First come the well-known articles of consumption, klip fish and stock fish. In 1904, nearly 31,000 tons of klip fish and 17,100 tons of stock fish were exported. A cheap and valued comestible is salt herring, of which there are considerable quuantities exported, as well as salt mackerel. Among other products of fishing and whaling may be mentioned fish oil, whalebone, and fish guano. Altogether, the exported products of seal, whale, and ordinary fisheries amount in value to about three millions sterling annually. The cultivation of the land has increased very considerably, and of agricultural products considerable quantities are exported. Special attention has been given to the development of cattle-breeding and of dairying. In 1904, 1,527 tons of Norwegian butter were exported, and 777 tons of margarine. Another article which is produced and exported in large quantities, is condensed milk, of which 11,000 tons were exported in 1904. Of the mining products, iron pyrites and copper are the most important. In 1904, 116,550 tons of iron pyrites and 2,700 tons of copper ore were exported. The new railway between Norway and Sweden, which terminates in the Norwegian town of Narvik, has made this seaport into a very important shipping centre for iron ore. Among other articles may be mentioned feldspar (exportation about 21,000 tons). The stone industry is also of some importance, both as regards pavings and stone for building purposes. About 190,000 tons of hewn stone are exported annually. The other branches of industry deserving of mention are the metal and machine industries, which in many respects have reached a remarkable degree of development, such as ship-building, the manufacture of horse-shoe and other nails, and the manufacture of machines and electrical appliances. Among the exported articles may also be included calcium carbide, which is largely produced, and of which 5,700 tons were exported in 1904, sulphur, vinegar, and acetic acid.

ORANGE INDUSTRY IN THE WEST INDIES.

The Imperial Department of Agriculture for the West Indies has printed a paper by Mr. H. Hesketh Bell, C.M.G., Administrator of Dominica, on the cultivation of oranges in Dominica, from which the following particulars are taken :—

Chief Orange Markets.—Oranges are produced more or less abundantly in all countries lying between latitudes of 40° north and south of the equator, but the world's great markets are chiefly supplied by fruit grown either in the Mediterranean, in California, or in Florida. Covent Garden relies for its principal supplies on Spain, Malta, and the country round Jaffa, while the demands of New York, Boston, and other great centres

of the Eastern States, are met by the products of the Pacific coast and of Southern Florida.

The magnitude of the orange trade may be realised when one considers that the annual imports into Great Britain comprise some 6,000,000 cases, amounting to a value of over £3,000,000, and that the output of California alone is not less than 9,000,000 cases a year. Owing to the occurrence of severe frosts and other disasters, the output of oranges from Florida has not increased in the same ratio as that of California, but the crop for this season is nevertheless estimated at about a million and a half boxes. The Cape and certain parts of Australia appear also to be suited to the production of citrus fruits, but, up to the present, the yield of these countries does not seem to be largely in excess of the local demand.

Natural Advantages of Dominica. — Land in Dominica suitable for growing oranges can be purchased almost anywhere in the island at prices varying from 10s. to £5 an acre. Owing to the generous rainfall, artificial irrigation is never necessary. The island's soil is proverbial for its fertility, while the climatic and meteorological conditions appear to be exactly suited to the successful cultivation of citrus trees. The wages of labour, instead of being from 4s. to 6s. a day, as in California and Florida, are barely a quarter of those rates, while the cost of living is proportionately low. Ample shipping opportunities exist for the conveyance of produce to Europe and America, and freight rates are not unreasonably high. Above all, it is being proved that oranges, under certain favourable conditions, can be produced in hill-districts far earlier in the season than is possible in California or on the Mediterranean, and the fruit may be placed upon the market at a time when supplies are short and prices correspondingly high. Judging by what Mr. Bell had seen of orange culture in Florida, the Bahama Islands, and in the Mediterranean, he believes that the local conditions in Dominica are far superior to those existing in most countries, and that a very promising and highly profitable industry may be founded.

Present Output of Oranges. — Dominica has, for many years past, been, more or less, an orange - producing country. There are fine trees scattered about, here and there, all over the island, and so greatly do they flourish by natural means that crops exceeding 5,000 fruits from individual trees are not uncommon. Such a yield anywhere else would be phenomenal, and we are thus encouraged to look for even more exceptional results when improved methods of cultivation are adopted. The export of oranges during recent years has varied between one and two millions of fruit, but in spite of this the industry has languished and cannot, in fact, be considered to have ever been taken up seriously. The results of shipments have usually been more or less unsatisfactory, and up to quite lately the possibility of a profitable orange trade was generally disbelieved. Mr. Bell attributes this stagnation in so promising an industry mainly to four causes; firstly, the complete absence of cultural methods; secondly, ignorance of the market's requirements; thirdly, inferior varieties; and, fourthly, rough and careless handling of the fruit.

During the past three years Mr. Bell made several experimental shipments of Dominica oranges not only to the London markets but also to New York. In making these shipments he was guided by information gained in Florida and in the Bahama Islands, and especially by notes made during rambles around Covent Garden market, and in chats with various fruit brokers. In most cases, the fruits were good typical specimens of the best Dominica oranges. The oranges were cured, graded, wrapped in attractive papers, and packed in the standard-sized Florida boxes, and the fruit arrived on the market in a shape no way differing from the usual American supplies which go to Covent Garden.

In September, 1903, six boxes, each containing on an average of 126 oranges, were sent to London. The brokers reported on them as being in excellent condition and of very fine flavour. They were sold by auction and realised from 10s. to 11s. 6d. a box. Apart from the cost of the fruit, the expenses for packing, wrappers, boxes, nails, export tax, freight to London and brokers' charges, amounted to a little under 4s. 6d. a box, thus leaving a margin of about 6s. for the value of the oranges contained in each package.

In November, 1903, seven boxes were sent to New York and sold for $13·25. The duty of $1·00 a box and the heavy Customs' charges swallowed up the profit, and this venture clearly proved that unless a higher price than $2 can be expected per box, shipments of oranges to New York can hardly be profitable.

The Jaffa orange can be highly recommended for culture in the West Indies. It is a large oval fruit of the first quality, the pulp is rich and juicy, there is little "rag," and seeds are frequently quite absent. The tree is very hardy, and bears early. There are several other varieties which appear to thrive admirably in these islands, and among them may be mentioned the "Parson Brown," the "Valencia Late," "Boone's Early," and the "Mediterranean Sweet." Any one starting an orange grove would do well to grow several varieties, and to give special attention to those which fruit very early or very late in the season.

The common sour orange, often found growing wild in Dominica, has been proved to provide the most suitable root-stocks for orange culture in the West Indies. Some nurserymen favour "rough lemons," but the one just mentioned is certainly the most vigorous and the most resistant to "collar-rot" or "mal-di-gomma." The fruit of the sour orange can be readily obtained here, and at almost nominal cost, during the last three months of the year. They must be perfectly ripe, and the seeds should be planted very soon after they have been

extracted from the fruit. They should be sown about 1 inch apart in drills 6 inches apart, and covered with ½ inch depth of soil. If very dry, hot weather be expected, a light screen of reeds or brushwood can, with advantage, be erected over the seed beds. The seeds should germinate in sixteen to twenty days, and the beds must be kept entirely free from weeds. In four to six months, the young seedlings should be about 6 inches high, and therefore fit for transplanting. Long, straight beds to receive them will in the meantime have been prepared, and into these the young plants should be moved, being set out in two or three rows, not less than 18 inches apart.

Conditions of Cultivation. — Although orange trees appear to thrive in Dominica, under almost any conditions, and where few other products would grow, still it is only reasonable to expect that far greater and more rapid results would be obtained where everything is favourable to good cultivation. Ideal conditions for an orange grove in this island would appear to be the following:—Altitude varying from 800 to 2,000 feet. Proximity to a good road and within easy distance of the shipping port. A gentle slope with a south or westerly aspect, and consequently well sheltered from prevailing winds. A rainfall of not less than 100 inches a year. A dark, friable soil, rich in phosphates and nitrogen, and thoroughly well drained.

Under such conditions and with good management, an orange grove should prove a very remunerative venture. Among the 100,000 acres of virgin land, which this island still possesses in the mountains and valleys of the interior, it ought to be no difficult matter to find considerable areas fulfilling every one of the requirements indicated.

Scale Insects. — In California, in Florida, and in most other great orange-producing countries, the planter is grievously plagued by various pests. He has to contend against the scale insects of all colours and of exceeding virulence, and it is only by a vigorous and permanent campaign that he manages to defeat their continuous attacks. Here, in Dominica, we are, so far, in the enviable position of suffering comparatively little from insect pests. Although there are in the West Indies no less than 120 known species of scale insects, only twenty-four of them are found in this island. Their numbers are, however, undoubtedly on the increase, and they constitute one of the chief dangers to a successful industry in oranges. It seems as if the budded varieties are far more liable to the attacks of scale insects than are the indigenous trees, and great vigilance is necessary to keep them free of pests.

Packing.—The wisdom of packing oranges only in boxes of standard size has been proved over and over again, and the use of barrels or rough-and-ready crates cannot be too strongly deprecated. The standard orange box, to which all the chief markets of the world are accustomed, measures 12½ by 12½ by 27 inches, outside measure, with a partition in the middle. The slats and sides for these packages can be bought in America, and the cost, f.o.b. at New York, is about 5d. per box. The Pierpont Co., Savannah, U.S.A., can be recommended.

The packer should very carefully examine every fruit, and discard every one that is in the least bruised, discoloured, or unsightly. Every orange should be neatly wrapped in white tissue paper, and carefully packed in layers. The top layer should project about ½ inch above the sides of the box, which will make the packing close after the cover is nailed on under gentle pressure. Every box should be stencilled on both ends, showing the grower's brand, the number of oranges in the package, and the quality. It is a well-known fact that a box of fruit nearly always sells on the merit of the poorest specimen contained in it. It behoves the grower, therefore, to spare no pains to ensure uniformity of quality in his produce. The following golden rules cannot be too strictly observed: "Grade carefully, pack firmly, and never ship an inferior fruit." The planter who follows these rules will soon get a good name on the market, and will always command a high price for his fruit.

Yield.—A grove of budded oranges will bear fruit very early. If well cultivated and healthy the trees will begin to produce a few oranges in their third year, and an average of fifty fruits per tree may reasonably be expected in the fourth year, with a steady and heavy increase in every succeeding season. In California and in Florida, two boxes per tree—that is to say, from 300 to 400 fruits—are expected in the sixth or seventh year of an orange grove, with a proportionately higher yield as the tree grow older. There is reason to believe, as I have already remarked, that the natural conditions found in the West Indies are far more propitious to orange culture than those of most other parts of the world, and I daresay that many of my hearers know of orange trees growing in Dominica which yield over 5,000 fruits each year. One of my budded trees at Sylvania gave last October 275 fruits, although it was only in its fourth year, and a crop of 400 oranges per tree in the seventh year may therefore not be, by any means, an excessive estimate for orange groves in this island. Calculating on that assumption, an acre of 100 trees, seven years old, should yield 40,000 oranges, equal to about 220 boxes. We have already seen that 4s. to 5s. per case is a reasonable and average net profit to expect on shipments of oranges of fair quality, and, at that rate, the produce from an acre should represent a value of about £45. The annual cost of cultivating an acre of orange trees in bearing should not exceed £4 a year, and expenditure on such a scale would allow for a liberal outlay on manures, spraying, and general care of trees. It will, therefore, be seen that a grove in Dominica may be expected to yield very handsome results.

The foregoing calculations are based on the assumption that the oranges produced will only be worth an average of 10s. a case, but where fancy

varieties, such as seedless oranges are grown, far handsomer results may be expected. "Washington Navels" and "Jaffas" will easily fetch from 15s. to 25s. a case. The cost of cultivation and transport would be no higher than in the case of inferior varieties, and the margin of profit would probably be much greater. There appears, therefore, no ground for refusing to believe that the annual return of £100 per acre often earned in California, Florida, and Australia, may not also be expected in Dominica.

GENERAL NOTES.

INSTITUTION OF NAVAL ARCHITECTS. — The summer meeting of this Institution will be held in London. Papers will be read at meetings at the Society of Arts on July 19th, 20th, and 21st. Visits to the works of Messrs. Siemens Bros. and Co., Telegraph Cable and Electrical Instrument Works, near Woolwich; Messrs. Vickers, Sons and Maxim, Ordnance Works, Erith; and Messrs. and E. Hall, Refrigerating Machinery Works, Dartford, are arranged for Wednesday afternoon. July 19th. On Thursday, July 20th, visits are arranged to R.M S. *India*, of the P. and O. Steamship Company; H.M.S. *Black Prince*, built by the Thames Ironworks Company, now fitting out in the Victoria Dock; Messrs. Yarrow and Co., Poplar; and to Messrs. Thornycroft and Co. Chiswick. On Friday, July 21st, there will be the visit to Portsmouth Dockyard.

RABIES.—Opinion was sharply divided as to Mr. Long's action in muzzling dogs, but it stamped out rabies. In his report just issued (Cd. 2454), the Chief Veterinary Officer is able to say that "this disease has been entirely extinguished in Great Britain, no case having occurred during 1904, and not a single individual has died of hydrophobia. Suspected cases of rabies in the dog have been reported in 1903 and 1904, but the results of the inoculation test with portions of the brain of all these suspected cases have proved to be negative in every instance." Mr. Cope considers that there are good reasons for believing that this terrible disease will never again appear in this country, as the regulations which apply to the landing of dogs from abroad are of so strict a character that a comparatively small number are now imported, and those which are admitted are kept under veterinary supervision for a period not exceeding six months. In certain cases the Board are prepared to sanction the removal of an imported dog, during the period of quarantine, to private premises, but in every such case the dog is required to wear a leather harness of a pattern approved by the Board, and may not be absent from the private premises unless it is also muzzled. While on a highway or thoroughfare, or while being moved by railway, the dog is required also to be controlled by a collar and a chain, or other attachment.

CO-OPERATIVE STORES IN GERMANY. — The system of co-operative stores ("Konsum Vereine") in Germany, through which the labouring classes especially have effected so great a saving in the past, is being more and more bitterly assailed by the shopkeepers, who are ever seeking Government aid in endeavouring to arrest the further spread of an institution by means of which their trade is being rapidly undermined. It is insisted on their part that all Government *employés* should be restrained from joining or forming such associations, and a counter-movement be thus inaugurated. Those interested in the scheme, however, are not being deterred, they have taken steps to strengthen their solidarity of interest, and now propose to pass from the plan of buying their supplies from the manufacturer direct to the still bolder scheme of becoming the manufacturers of needed supplies themselves. According to the latest statistics, these associations in Germany now embrace 628 separate organisations, with a total membership of 480,000, and an annual turnover of £6,000,000.

THR TRADE OF TANGIER.—Mr. Acting-Consul Wyldbore Smith's Report on the Trade of Tangier for 1904 (No. 3426, Annual Series) shows a considerable shrinkage, due mainly to the disturbed state of the neighbouring district, which resulted in the road between Tangier and Fez being so insecure that merchants were unable to send goods by this road to Fez at any time of the year, and to a bad harvest. The United Kingdom did not do quite as well as in 1903. British trade, on account of its staple imports being those which are most in native demand, such as cotton goods, candles, tea, &c., depends, almost more than that of any other nation, on the native consumption and on the Fez market, both of which sources of prosperity for British import trade have greatly diminished by the reasons above stated. On the other hand, Germany benefited by the large amount of cheap cloth imported, which, owing to the impecunious state of the natives, was in much greater demand than the more expensive British material. Nevertheless we find that the imports from the United Kingdom were 33¾ per cent. of the whole, whilst from Germany they were only 8 per cent. Of the exports the United Kingdom took 25 per cent., and Germany only 1½. Mr. Consul Smith says that with the steady influx of Europeans to Tangier, a great demand for furniture has sprung up, cheap, light furniture, such as stained wood and bamboo and basket work goods. Owing to the failure of the harvest, and the withdrawal of the Sultan's permission for coastwise trade, there is, the Consul says, a great demand for flour, and especially semolina. French and Italian millers are reaping a rich harvest, in which British millers might have a good share.

Journal of the Society of Arts.

No. 2,748. VOL. LIII.

FRIDAY, JULY 21, 1905.

NOTICES.

COLONIAL SECTION COMMITTEE.

A meeting of the Committee of the Colonial Section was held on Wednesday afternoon, 19th inst. Present:—Sir Westby B. Perceval, K.C.M.G. (Chairman of the Committee), in the chair, Byron Brenan, C.M.G., Hon. Sir John A. Cockburn, K.C.M.G., Robert Kaye Gray, Hon. Walter Hartwell James, K.C., Agent-General for Western Australia, Sir E. Montague Nelson, K.C.M.G., Earl of Stamford, with Sir Henry Trueman Wood, M.A., Secretary of the Society, and S. Digby, Secretary of the Section.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

INTERNAL COMBUSTION ENGINES.

By Dugald Clerk, M.Inst.C.E.

Lecture III.—Delivered February 27th, 1905.

Syllabus.

Examples of Internal Combustion Engines in Britain.—Clerk cycle engines, Koerting, Oechelhauser—Constant pressure cycle engines—Coal gas, producer gas, and blast furnace gas engines, Crossley, National, Premier, Cockerill, Deutz.

In my last lecture I dealt with the various questions which bore upon the economy and operations of the Otto cycle engines. I spent nearly the whole evening considering their cycle; so now I propose to take up first the Clerk cycle and its modifications, the Koerting and the Oechelhauser, and then the constant pressure engines, like the Brayton and the Diesel, and other engines of that type. As I have gone fairly fully into the particular points on the Otto cycle, I need not trouble you with such minuteness to-night upon the Clerk and the other cycles, so I will run rather quickly over those matters, so as to show photographs, and discuss some of the practical points in connection with the large gas engines.

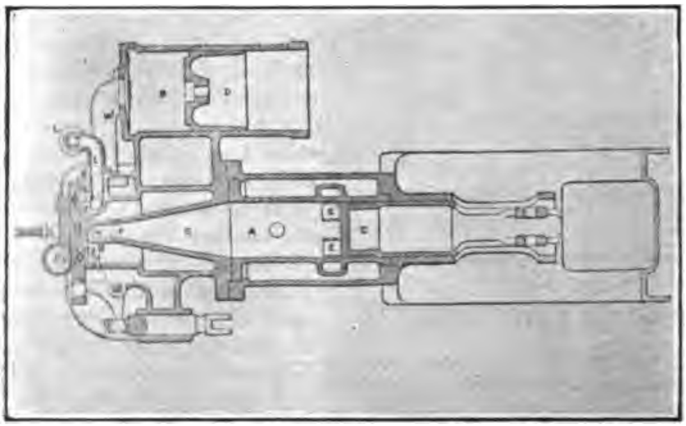
To begin with the Clerk cycle engine: this engine is not so well known to-day as it was more than twenty years ago, so I think it desirable to describe it with reference to Fig. 23, which is a sectional plan. In the Clerk engine the motor cylinder had, at the front end, large ports leading into an annular space, these being the exhaust ports. The compression space was conical, and the charge was sent in by means of a separate pump, which I called the displacer. The action of the engine was as follows:—When the piston got to the out end of its stroke, and the crank was crossing the out centre, the piston overran the exhaust ports on the out-stroke, and covered them on the in-stroke. Meantime the pump or the displacer piston, which was attached to a crank at right angles in advance of the main crank, was sweeping in and giving its charge a slight compression. That charge passed through a connecting pipe, and through a check valve, into the conical end, displacing before it all the contents of the cylinder. When the main crank had returned about 40 degrees of its circle under the centre, these ports were closed. It opened about 40 degrees above and closed 40 degrees under, and in that time the displacer piston had gone fully in and discharged its charge into the cylinder and combustion space through the lift valve. Then the motor piston compressed the charge, and ignition took place at the in end of the stroke, just as in the Otto cycle. The object of the invention was to enable one motor cylinder to give an impulse at every revolution. In the Otto cycle there is only one impulse for two revolutions, so far as the main cylinder is concerned. The Clerk engine gave one impulse for every revolution of the main crank in the main cylinder, but, to make that possible it was necessary to provide an auxiliary crank and displacer cylinder. The idea, was, of course, to diminish the irregu-

arity of the Otto cycle by having an impulse at every revolution, or more frequently, that is to say, two impulses per revolution, obtained by making the engine double acting. The object was to get very much more power for a given weight of engine, as the pump was light and only required to deal with its charge at a low pressure. In construction the engine was a very simple one.

Fig. 24 compares the diagrams obtained from the Clerk and the Otto cycles. In the four stroke cycle diagram there is clearly seen the charging stroke, the compression stroke, the explosion and the expansion, and then the point of opening the exhaust valve and exhausting the burnt gases. In the two stroke or Clerk diagram there is nothing shown upon the main indicator card of the charging stroke, because immediately the piston overruns the exhaust ports the pressure falls almost to atmosphere, and then the displacer piston at right angles in advance of the main crank discharges its charge into the cylinder while the main crank is crossing the centre. Compression of the charge then takes place, and ignition, expansion and exhaust follow as I have described.

In the Clerk cycle engines the considerations which govern power and economy very closely resemble those of the Otto cycle, but there are several points which require to be carefully considered—points, indeed, of considerable difficulty—with regard to which the Otto cycle is a far easier cycle than the Clerk cycle. In the Clerk cycle, the charging has to be accomplished in the motor cylinder, while the crank is passing through an angle of about 80 degrees. Sometime a little larger angle is allowed, but, roughly, 80 degrees of the crank angle is the limit for charging of the motor cylinder. Because of this, much larger inlet valves and very much larger discharge areas are required in the Clerk than in the Otto cycle. In the Otto cycle the charging stroke occupies not only the whole of one stroke, which amounts to 180 degrees of the crank movement, but in addition a further 40 degrees, which permits the inlet valve to be held open considerably over the out centre, and also to be opened a little before the centre on the in-stroke. In consequence, the Otto type of engines allows three times the time interval to charge the cylinder, at a given rate of revolution, that it is possible to allow in the Clerk cycle. For a given valve area, the velocity of charge entrance in the Otto cycle is about a third of that in the Clerk cycle. This means that the Clerk cycle engines are more difficult to charge, and require greater power expenditure to charge the cylinder than the Otto cycle. That is the great weakness of the Clerk cycle as constructed at present.

FIG. 23.

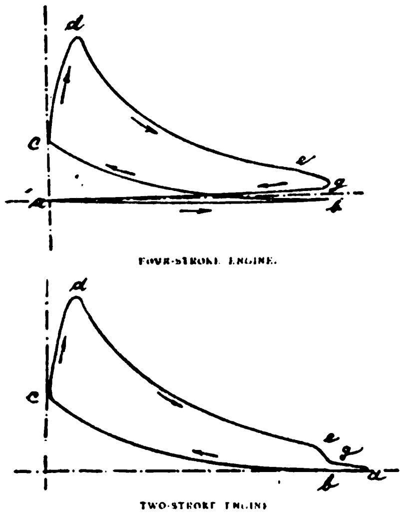


SECTIONAL PLAN OF CLERK CYCLE ENGINE, 1881.

Then there is this further point. In the Otto engine, when the piston moves out, taking in its charge, there is no question of any possible discharge at the exhaust ports, because the piston is sucking in the charge by a partial slight deficit of atmospheric pressure, and there is no exhaust port open through which fresh charge may be lost. In the Clerk cycle, the proportions of displacer and motor cylinder have to be very accurately ascer-

tained, otherwise part of the charge entering the cylinder is apt to pass right down through the centre of the exhaust gases which are being displaced, and pass out of the exhaust port. That was overcome in the early Clerk engines by the peculiar conical shape of cylinder end, which has been since consistently adhered to in all the engines operating on the Clerk cycle. That difficulty, however, is met in two ways. One way is to put in a smaller charge than in the Otto cycle, but that has the disadvantage of leaving too much exhaust gas, and also giving you a smaller power of engine. Conse-

FIG. 24.



COMPARATIVE INDICATOR DIAGRAMS FROM ENGINES WORKING ON THE CLERK AND OTTO CYCLES.

quently, every designer of the Clerk cycle engine attempts to get in the full charge. The best method is to send into the cylinder, first a good heavy charge of air to displace the exhaust products, and then to follow it with a somewhat strong charge of gas and air. That is what I did in 1881, and that is what is being done to-day in all the large gas engines. That, however, is a somewhat difficult thing to do. The consequence is that if one of these cylinders be charged as fully as it would be in an Otto cycle, a slight proportion of gas is lost at the exhaust ports, and although in a small engine with a comparatively light load, the economy very closely approaches the best Otto economy, yet the maximum efficiencies that are possible with the Otto cycle have not been obtained with any two cycle engines. Because of this, the Clerk cycle has been reserved for somewhat special uses. It has come into extensive use of recent years in connection with large blast furnace gas engines.

The modern representative of the Clerk cycle engine is known as the "Koerting" engine, a German production, but so far as its essentials are concerned, it was invented in England twenty-three years ago. The engine is shown in Fig. 25. The charge is admitted at the inlet valves placed at the conical ends of the cylinder, and instead of having one pump for gas and air mixed, two pumps are provided, one of which is for gas, and the other for air. This engine, instead of being single-acting as the Clerk engine was, is double-acting, so that, so far as the main crank is concerned, there are two impulses every revolution just as there are in a steam engine.

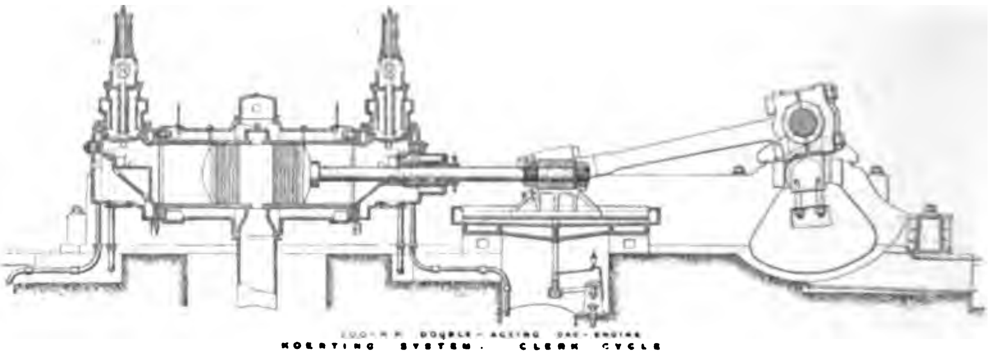
In this Koerting engine, the piston in the position shown is overrunning the exhaust ports at one end of its stroke, allowing the pressure in the cylinder to fall to that of atmosphere.

Fig. 26 is the diagram of the engine, showing the fall to atmosphere just at the point where the piston overruns the ports. Then immediately the pressure has fallen to atmosphere (this requiring about 20 degrees movement of the crank) the charge inlet valve is opened and air is first pumped in from the air pump. After the air has been flowing in for some little time to throw the exhaust gases forward, the gas is pumped in from the same valve, so that no mixture is made until the gas and air mixture enters the cylinder. That is a very important point. In a small engine the gas and air may be mixed in the pump, but in a large engine the charge of gas and air must be mixed just as it enters the cylinder. In a small engine an occasional back ignition into the displacer is no great matter; in a large engine it will be a serious matter; so that in the large engine the gas and air are kept separate until they flow into the motor cylinder. When the charge has entered, air first and then gas and air, and has displaced the exhaust products, the piston is closing the ports which shut off the exhaust after a movement of about 40 degrees of the crank; the compression then proceeds, and ignition and expansion take place, so that an impulse is obtained at every forward stroke behind the piston, and at every backward stroke in front of the piston. If it were possible to charge the cylinder with absolute certainty, without any chance of loss at the exhaust, there would be a great deal to be said for this cycle,

because it undoubtedly gives a very powerful engine for a comparatively light weight, and in very large engines the question of economy is not the pressing question. In large engines the pressing question is to get an engine that will run without breakdown. The amount of experience accumulated in the world with large engines is not as yet sufficiently great for the engineer to assure himself that, when he designs a big engine, it will work as smoothly and uniformly and with as little expense for up-keep as a large steam engine. It would be rather unnatural is about 1-6th of a second—between one explosion and the other. In the Clerk cycle engine the metal has no such rest: immediately the one explosion has finished, the new charge is put in and compressed and exploded again, so that the metal is strained somewhat more than on the Otto cycle, although that is not found to be a very serious point.

Now, in addition to the Koerting engine, there is another engine somewhat on the same lines; that is, an engine in which the exhaust gases are displaced through ports in the side of the cylinder by the entering charge. In

FIG. 25.



at this present stage of the career of the large gas engine, if it did work so uniformly and smoothly. As a matter of fact, the larger engines are very rapidly improving, but as yet there are many difficulties apart altogether from economy, so that, although one is discussing the economical points of these engines, it must not be thought that the point of economy is by any means the leading point with regard to very large engines. In addition to the difficulty of charging the Koerting engine, due to the fact that the cylinder can only be charged through a small crank angle, there is a further difficulty due to the fact that, for a given flame temperature, there are double the number of flame impulses upon the piston in a given number of revolutions. The effect of this is that, in the Otto cycle, although there may be a watered piston, still it does not matter whether the piston is watered or not, or whether the jacket is watered or not; but in these large engines the terrible flow of heat through the side walls causes, undoubtedly, a severe strain on the metal. In the Otto cycle, all the metallic parts which have been highly heated by an explosion, have a rest of a fraction of a second, which, it is true, is not very much in an engine of 160 revolutions—it

the Oechelhauser engine shown in Fig. 27, that is what is done. It is a very interesting engine, and it runs with great smoothness. I had the pleasure of inspecting several Oechelhauser engines in Germany some time ago. The engine has two opposing pistons,

FIG. 26.

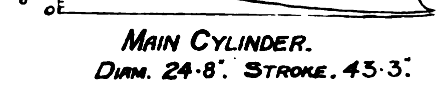


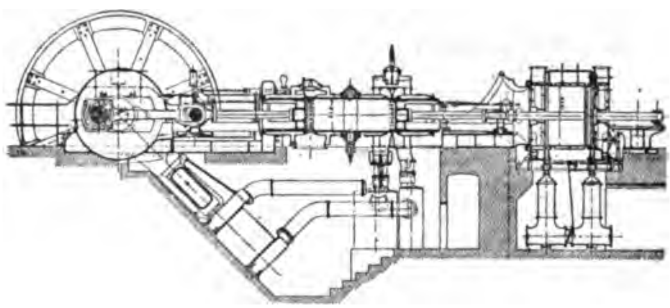
DIAGRAM FROM KOERTING ENGINE.

driven from a crank in the front part of the engine; there are three crank pins, one the main crank pin driving the front piston; then outside of that there are two other crank pins, disposed exactly opposite, that is, 180 degrees from the main crank. These two opposite pins drive separate side rods and

cross-head, and the two pistons therefore move out at equal velocity. This arrangement produces a very nicely balanced engine, all the strain of the explosion being removed from the frame, and taken by the cranks only. The two pistons overrun the ports, the one at one end and the other at the other. In the front end, the piston overruns the exhaust ports, and the pressure falls to atmosphere exactly as it does in the Clerk and the Koerting engines. A little later the back piston is overrunning the air ports, shown in Fig. 27, as a series of holes. The air is accumulated by means of a pumping arrangement, and this air first runs into the cylinder from ports placed all round it, driving out the exhaust gases. In this way the cylinder is cleared of the hot incandescent matter before the gas enters. Then as the piston moves further back the next ports are uncovered, and the gas enters, coming from a separate reservoir. The mixture of gas and air runs right up to the cylinder, and discharges the exhaust gases and the air that has been put in first; then compression takes place, and then ignition, expansion, and so on, just as in the other cycles. The engine illustrated is a blowing engine for a blast furnace, the blowing cylinder being directly coupled on to the piston rod. This engine has one great advantage over other forms of engine working on the Clerk cycle, viz., that there are no valves so far as the combustion and explosion is concerned except the pistons themselves. The two pistons form the whole of the valve arrangements, and no pressure of explosion can come on any other valve. There are no lift valves exposed to the consequences of the explosion, so that a very large valve area may be allowed. The engine, however, has disadvantages. It is a more expensive engine to build, and a very considerable weight of metal is required for a given power, but it is a very smooth-running engine, and, although it does not come up quite to the Otto cycle in economy, it has given great satisfaction in Germany, and is, I believe, running very well in England from the point of view of requiring but little repair. The well-balanced pistons, and the fact that only wide open ports are overrun by the pistons, make it eminently suitable for gases such as blast-furnace gas, which would always carry a slight amount of dust with it.

Another modification of this type of engine is found in the Day engine, which was produced many years ago: it was called a valveless engine. In this engine the front end of the cylinder and the crank was enclosed in a casing, very much like the modern petrol engine, and the front end was used to take in charge which was to displace the exhaust products at the back. The consequence of that arrangement was that you could run the engine with an impulse at every revolution without the displacer. Many engineers in America have taken up that particular modification of the Clerk cycle, and it is very commonly used for small launches and marine work; but one often sees in motor and other papers that great surprise is expressed that more power is not obtained from an engine of the type. The reason is clear. If the piston of the engine displaces only its own volume of charge into a comparatively large space, when the clearance is great and the pressure in that space falls, the whole of the contents of that space, owing to the large clearance, cannot possibly be discharged, and only about two-thirds of the piston stroke charge passes in behind the piston. The consequence is that we have a

FIG. 27



SECTIONAL ELEVATION OF OECHELHAUSER GAS BLOWING ENGINE.

charge which is one-third less than the Otto charge, and a larger proportion of the exhaust. This makes it necessary to use lower compressions in order to avoid pre-ignition. The general effect of that cycle is that instead of getting, as in the Otto cycle, a mean pressure in a small engine of 80 lbs. on the square inch, not more than say 45 lbs. to 50 lbs. is obtained, and then, although there is an impulse every revolution, nothing like double the power of the Otto cycle is obtained, and the front casing must be made heavier. If any engine is to give the full average pressure possible, some device such as I have used, to give the full charge, must be provided. This may be done on the Clerk cycle with a displacer, because the displacer may be regulated as desired, but it cannot be done in these little American engines.

I have now run quickly through the different points of the Clerk cycle, that is, the points wherein that cycle differs from the Otto. So far as the ideal efficiency is concerned, the formula given in the first lecture holds for the Clerk cycle as well. The only difference is that the difficulties in keeping down the temperature of the charge are much greater in the Koerting and Clerk cycle than in the Otto.

In dealing with the constant-pressure engine, it will be well to bear in mind the formula, now well established, for the ideal efficiency of the constant-volume engine, that is, the Otto cycle and the Clerk cycle, in the case where expansion is carried to the volume occupied by the charge before compression. The efficiency of engines of that type is—

$$E = 1 - \left(\frac{1}{r}\right)^{\cdot 408}$$

In the constant-pressure cycle, where expansion is carried to the same pressure as before compression, the ideal efficiency is given by the same formula. In the Diesel, or the constant-pressure cycle, where expansion is not carried to atmospheric pressure, the efficiency is different, it is as follows :—

$$E = 1 - \frac{T_1 - T_0}{1{\cdot}408\,(T_x - T_c)}$$

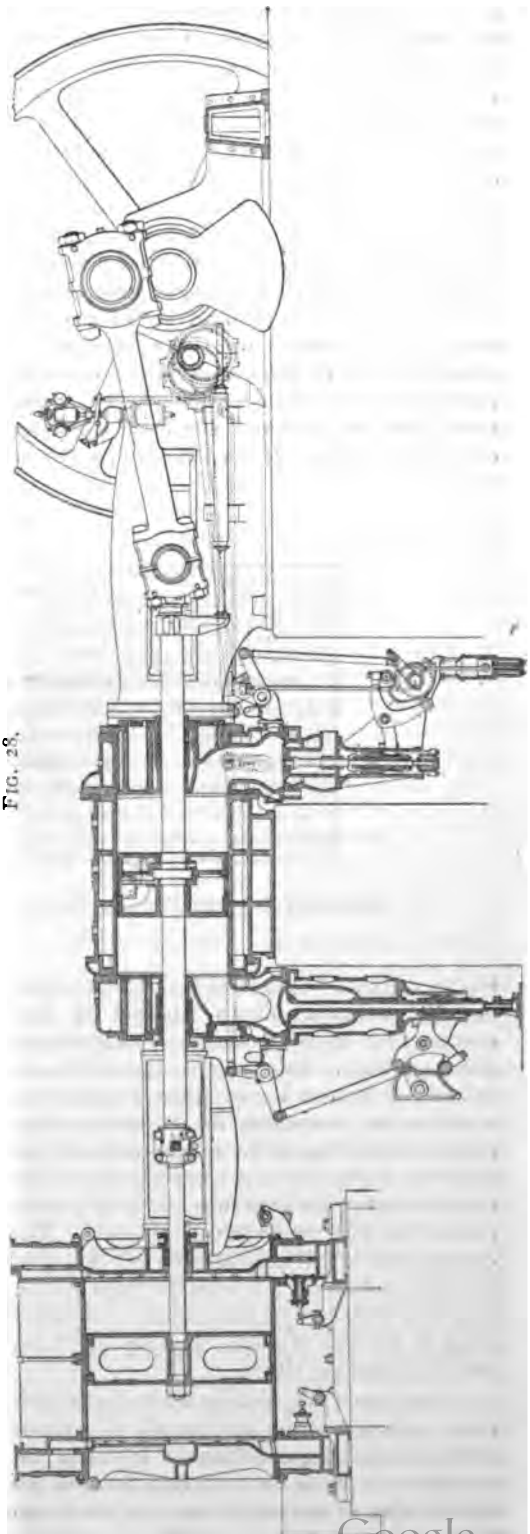
In this formula which I worked out some little time ago, T_0 is the temperature of the charge before compression; T_c is the temperature on compression; 1·408 is the ratio of the specific heats; T_x is the maximum temperature of combustion; and T_1 is the temperature at the end of the expansion. You see that in this case there is a much more complicated formula than the formula in the constant volume cycle.

Diesel started with some erroneous notions as to what he was going to do; his idea was that he was going to follow the Carnot cycle. In the Diesel engine the piston takes in just as on the Otto cycle (it can work on that cycle, or on any other cycle) a charge of air only—not gas and air, but air only. It compresses that charge up to a pressure of about 500 lbs. per square inch. At that pressure the temperature of adiabatic compression is so high, something in the neighbourhood of 700 degrees Centigrade, that any oil injected into the cylinder with air at once ignites without the use of any outside igniter. Diesel thought he was going on the Carnot cycle, but what he, in fact, did, was to get the advantages of the constant pressure cycle without the danger of pre-ignition or explosion or compression by having air in the cylinder only. Of course, it is impossible to pre-ignite, because there is nothing to burn in the air. Oil and air were added by means of a sprayer when the compression was complete, the air being previously compressed to about 150 lbs. to the square inch above the pressure in the cylinder, that is to say, 650 lbs. On injection of the oil, ignition takes place and then expansion.

In his description of the engine which he called a Rational Heat Motor, Diesel suggested that other inventors or designers of engines were proceeding upon wrong principles, and that the right principle was to rise to the maximum temperature by compression, add heat at the maximum, and have no increase in temperature after your compression. In his first engine, he thought he had done that; but it is obvious that if it is desired to follow the Carnot cycle, instead of having a pressure of about 50 atmospheres to get the maximum temperature used in this engine, a pressure of about 200 atmospheres is required. That, of course, means that heat must be added on the expanding line. Working on the Carnot cycle, as I showed in my first lecture, an extremely slender diagram is obtained, and an enormously heavy engine is required. Diesel did not notice what has recently been noticed, that the efficiency of the Carnot cycle, constant volume and constant pressure engines are all exactly the same if you have the same compression. The consequence is, that you gain nothing by going to the Carnot cycle. Diesel, in some of his recent papers, still adheres to the idea that he is dealing with a modified Carnot cycle, but all heat

engines may be considered as modified Carnot cycles, one as well as another. Twenty years ago I was in the habit of drawing Carnot cycles, and of cutting out a slice to represent any given engine. If you take the Carnot cycle, and take the compression curve, and take a vertical line for heat addition, you have the constant-volume engine. If you take the Carnot cycle, and add heat along a horizontal line, you have a constant-pressure engine. You can carve out of the Carnot cycle any engine you like, but you must not say, when you have carved an engine to suit your own convenience, that you are now working a Carnot cycle, and that the engine is therefore different from any other. What Diesel has, in fact, done is to use very high compressions on the constant - pressure cycle, on the formula which I have given above. Many attempts have been made to carry out constant-pressure engines for gas. Diesel has tried them. I myself built an engine in 1887, a diagram from which is reproduced at Fig. 22 (see previous lecture). This was a constant - pressure engine, or a modification of constant pressure and constant volume, somewhat like Diesel. In 1888 I had an engine of 9-inch cylinder, 15 inches stroke, with a compression space into which air alone was compressed. The ordinary coal gas was taken into a separate pump, working at about 50 degrees behind the main crank; this gas was compressed and ejected into the air when compression was complete, but I arranged a peculiar igniting device, so schemed that immediately the gas began to flow into the air it ignited, so that there was no explosion, but only the constant-pressure combustion. That engine worked extremely well. It was running well in 1888 for more than six months, and was perfectly free from gas-engine troubles, but the difficulty was that, with economy, only very low average pressures could be obtained. The average pressures I obtained with this engine were in the region of 30 lbs. to 40 lbs., instead of 70 lbs. to 80 lbs., as then obtained with the Otto cycle, or 90 lbs., as now usual. So far as that cycle is concerned, there is no doubt that a great deal has to be done yet in the way of constant-pressure engines. Many people have tried, including Diesel himself, but so far the difficulties have been too great to put any succcessful engine on the market. Brayton, in 1878, produced a gas engine of the constant-pressure type, but he compressed his gas and air separately into reservoirs to feed his cylinders at constant pressure. This

FIG. 28.

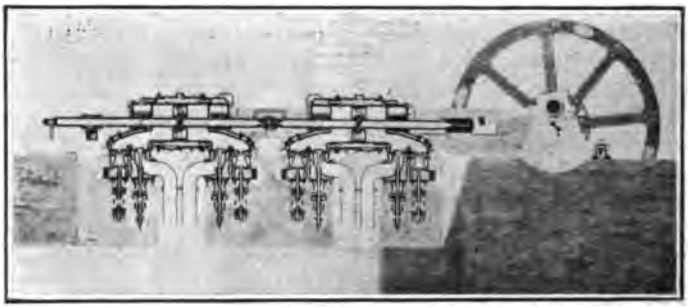


1800-H.P. COCKERILL GAS-ENGINE.

engine, however, was rather troublesome; it gave frequent back explosions, and there were two or three rather bad accidents with it. So far as oil was concerned, his engine was fairly successful, but he never succeeded with gas, the reason being that all constant-pressure engines, whether of the Brayton type, or of the Diesel type, or of the old type I tried, require gas to be stored up under enormous pressures. The gas before being mixed with air must be compressed to the full pressure. If we take, for instance, a cool mixture of gas and air, and apply compression to the full pressure, on ignition we get a pressure of about two tons on the square inch, a pressure which would require extremely heavy reservoirs. This is, perhaps, the chief difficulty of the Diesel type. If the charge in a Diesel engine happens to get in at high temperature, and the cylinder misses ignition by any chance, as I believe in the early experiments it did—at least, I should have expected it to do so, and I believe it did—then an explosion would occur. Supposing the mixture is compressed to 500 lbs. on the square inch only, an explosion occurs, and a comparatively small rise of temperature soon runs up the maximum pressure to one ton on the square inch. The consequence is that you really do get explosion and not combustion. That is the main reason why the constant-pressure type has never come in for gas engines. Nobody has been able to control the effect.

I want to run over quickly a few of the ordinary engines, because you are all so familiar with the ordinary gas engines. It will be unnecessary for me to do more than refer to the smaller sizes of engines of this sort, about 100 horse, mere matters of ordinary commercial daily work.* These engines are not so interesting because we have overcome all the difficulties. It was not true at one time to say that the difficulties were overcome, but now it may be said that up to 300 horse our difficulties have been overcome in gas engines, and the difficulties begin at about 300 horse and above Below that everything is absolutely dividend paying; but above that in large engines there is undoubtedly considerable room for difference of opinion, to say the least of it, among different engineers, and engineers are fighting out the battle of the big engine at present. I have no doubt that in a very short time they will be found to be quite as efficient as the smaller ones; but one cannot pretend that they are really in the position of the small engines that we turn out in great numbers.

FIG. 29.



VERTICAL SECTION TANDEM DOUBLE CYLINDER ENGINE. COCKERILL TYPE.

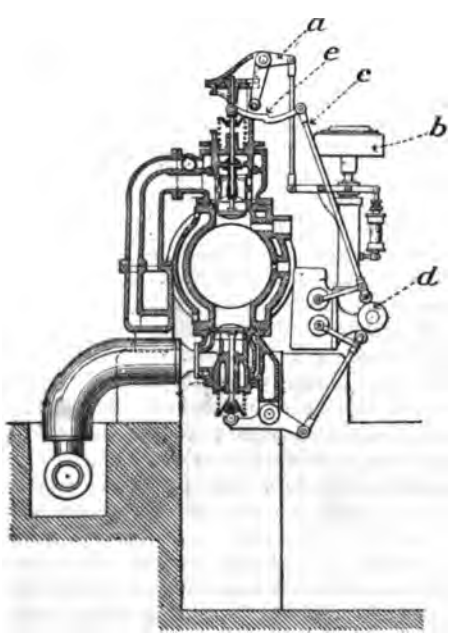
We now come to really large engines. The great difficulty at present in the large gas engines is that they are much too large for the power one gets. Fig. 28 shows a 1,200 horse Cockerill two cylinder engine. This engine gives an impulse at every revolution. In the Cockerill engine two separate valves are provided outside the main inlet valves, one for air and one for gas. The object of this is to arrange matters so that blast furnace gas can be used in these large engines. It does not do to allow any chance of air getting back into the gas end, or the gas end going to the air.

There is a very large installation of six Cockerill engines at the Cargo Fleet Iron Company works at Middlesbrough, each giving 900

* Lantern slides and photographs were shown of the following engines of various sizes with their indicator diagrams: Koerting, Oechelhauser, Diesel, Crossley, National, Premier, Cockerill, Deutz.

horse-power, so that the total horse-power is 5,400. These engines are the first built by Messrs. Richardsons, Westgarth, and Co., in England. They are extremely well thought out, and work satisfactorily. Fig. 29 shows an example of the tandem double cylinder engine, double acting, of the Cockerill type, at Messrs. Cochrane's at Middlesborough. The crank axle is placed at one end of the engine, which is provided with two double-acting cylinders, arranged tandem, the piston being carried right through. The valves admitting to the

FIG. 30.



SECTION OF VALVE BOX DEUTZ GAS ENGINE.

cylinders are arranged below the engine. This, however, is rather an objectionable arrangement, because the great difficulty in these large gas engines lies in the strains introduced by expansion, and everything should tend to allow of perfectly free expansion. A great many of the troubles we have met with have been due to failure to realise the intense temperature of the explosion and expansion. For instance, taking the engine shown in Fig. 29, there is a combustion chamber about three or four feet long, and the metal must be strained very badly indeed. In later engines the makers have improved the engine in this respect by placing the valves at the top and bottom. Difficulties such as these cannot, however, be thrashed out except on a large and extensive scale on the actual engine.

Most large engine designers are now going in the direction of double cylinder, double-acting engines, both in this country—as shown in the Cockerill engine above referred to—and on the Continent in the Deutz engines. The reason for this is obvious. By using two double-acting cylinders, tandem, the power is doubled with small weight addition—little more than the addition of the extra cylinder—so that the crank is fully utilised and the weight for a given power materially reduced.

Fig. 30 is a cross section of the valve arrangement of the Deutz engine showing the governor gearing. In the ordinary large gas engine the hit-and-miss system has often been used, but in the more modern engines, the governing is more like that which is usual in a petrol engine, that is the charge is throttled. In the case illustrated the charge is throttled by the governor, *b*, operating the bell crank lever, *a*. When the rod, *c*, is lifted by means of the cam, *d*, it leaves the governor quite free to define the fulcrum of the lever, *e*. When the governor operates, the lever, *a*, is correspondingly moved, changing the position of the fulcrum of the lever, *e*. The consequence is, that though the cam lifts the rod at the same time, and opens the valve at the same time, the lift of the valve is varied, and in that way a very good governing is obtained.

ROTTERDAM AND HAMBURG.

Although the needs of the Port of London have been under Parliamentary consideration for many years past, and a Bill was framed upon the report of a Royal Commission, which urged urgency, and tabled, both last year and this, there is no likelihood of the necessary charges and expenditure being sanctioned during the lifetime of the present Parliament. Meantime, the authorities of Antwerp, as was recently explained in the *Journal*, have sactioned expenditure upon port improvements expected to reach five millions sterling, and two official reports just issued (Mr. Consul Turing's Report on the Trade of Rotterdam for 1904, No. 3391, Annual Series, and Sir William Ward's Report on the Trade of Hamburg, covering the same period, No. 3393, Annual Series), show the great progress that continues to be made in the shipping business of those two great seaports, Hamburg and Rotterdam.

Taking first the smaller of the two, Rotterdam, the most important event of last year connected with shipping interests was the completion of the fourth municipal dock, which was commenced in 1902, and ranks amongst the largest in Europe. Its length is 556 feet, with a breadth of 118 feet, and its lifting

capacity is 15,600 tons, while its total weight amounts to 6,500 tons. All the necessary appurtenances are worked by electricity, supplied by a station on the left bank of the river. Its total cost slightly exceeded £100,000. There are three other municipal docks in the port, whose lengths are respectively 360, 295, and 158 feet, and the fifth dock, owned by a private company, is capable of accommodating vessels of 7,500 tons. It is satisfactory to find that in 1904 the United Kingdom held its own at the port as compared with 1903. It is true that British shipping showed a decrease upon the year of 404,365 tons, and only represented 35 per cent. of the total of the port as against 39½ per cent. in the preceding year; but this diminution is solely due to the fact that the Harwich daily passenger steamers ceased running to Rotterdam, the voyage from the United Kingdom now terminating at the Hook of Holland, and hence their tonnage is excluded from the returns for Rotterdam. But for this circumstance the total entries of British ships would have exceeded those for 1903 by 40, and the tonnage would have shown an increase of 158,850 tons. But whilst the figures (making due allowance for the diversion of traffic as explained above) of 1904 are rather more favourable than those of its immediate predecessor, a comparison of the figures of the last ten years is disturbing. The percentage of the total tonnage of shipping entering the port of Rotterdam in 1895 under the British flag was 69; in 1900 it had fallen to 52; last year, as stated, it was 35. The decrease in the actual tonnage has been very slight—from 4,481,649 tons in 1895 to 4,419,373 tons in 1904—the significance is in the fact that the whole of the immense increase in the entries has gone to the continental rivals of the United Kingdom. Whilst the British tonnage entering the port has decreased by 62,276, the total entries in the same period have increased from 6,489,494 tons in 1895 to 12,603.550 tons in 1904. These figures indicate the volume of transmarine business, but a large additional amount of tonnage is represented by the arrival of 126,877 river craft with a capacity of 6,746,784 tons.

The commercial importance of a large seaport should not be altogether measured by, and does not chiefly depend upon the amount of sea-going tonnage frequenting such port, but rather upon the volume and value of the merchandise imported and exported. The following figures, taken from a report recently published by the Antwerp Chamber of Commerce, and quoted by Sir William Ward, would seem to show that the importance of Hamburg in this latter respect greatly exceeds that of Antwerp, and even that of London or Liverpool:—

	Value.	
	Total Imports 1902. Francs.	Total Exports 1902. Francs.
Hamburg	4,709,000,000	4,139,000,000
London	4,189,000,000	2,340,000,000
Liverpool	3,180,000 000	2,720,000,000
Antwerp	1,778,000,000	1,642,000,000

The aggregate number and tonnage of the seagoing ships of all nations entering the port of Hamburg in 1904 was the largest on record, the total registered tonnage having exceeded that of ships entering in 1903 by 455,000 tons. The aggregate number of sea-going ships which entered the port during the year was 14,859, and their total registered tonnage 9,611,732 tons. There was an increase of 177,288 tons register in the aggregate tonnage of the British vessels visiting the port as compared with 1903, the figures of last year both of the aggregate number and tonnage of the arrivals under the British flag having been the highest on record. Taking the last five years, there has been unbroken increase in the total annual tonnage of British ships entered, but it is to be noted that the increase in the total tonnage of German vessels entered during the same period has been greater. Of the 9,611,732 tonnage entering Hamburg in 1904, 3,353,147 was under the British flag, and 5,231,714 under the German.

Nothing, perhaps, in the history of shipping has been more remarkable than the rise and growth of the Hamburg-American Steamship Company. At the end of last year this company owned 310 sea and river-going vessels of all kinds, of an aggregate tonnage of 738,694 tons register. The aggregate tonnage of sea-going vessels alone was 612,299 tons register, and the aggregate tonnage building at the end of the year was 110,000 tons. The total number of passengers carried by the company in 1903 (the figures for 1904 are not yet available) was 304,346, and the quantity of cargo 4,800,554 cubic metres. The number of different lines maintained by the company, partly alone and partly in conjunction with other companies, increases steadily from year to year. At present the company carries on altogether 44 different services in various parts of the world, the most important being those to North America, to Mexico, the West Indies, the East and West coast of South America, and to Eastern Asia. The total profits realised in 1904 were £1,560,000, a result due on the one hand to the high prices paid by the Russian Government last year for several steamers sold by the company, and on the other hand to increased receipts on account of goods traffic on some lines, and also to the effects of the recently established system of insurance. That the company owes its success in great measure to its being constantly alive to the introduction of every possible modern improvement, not only as regards the construction, speed and safety of its ocean-going steamers, but also in regard to the accommodation and comfort of every description provided for passengers is well known. As an indication of the latter it may be mentioned that in some of the company's steamers passenger lifts have lately been constructed, the use of which, especially in rough weather, is certain to be much appreciated by passengers. Then a considerable space on board the company's tourist steamers is given to apparatus for hygenic gymnastics, and in some of the newest steamers restaurants are to

be found in order to offer passengers the option of taking their meals alone and at any time instead of being obliged to conform to the hitherto customary meal arrangements. Further, to attract passengers to use its steamers the company has recently taken over the entire business of a well-known German travelling agency, and intends establishing branch agencies in various countries.

Whether imports or exports are taken the United Kingdom is at the head of the list as far as Hamburg is concerned. Of the total imports by sea in 1904 amounting to no less than £125,203,520. £20,823,;0) came from the United Kingdom, the United States coming next with £19,753,229. It is noteworthy that India is third with £12,952,305. The chief articles of import to Hamburg, from India, are hides and skins, oleaginous seeds, rice, bone flour, myrabolans, cotton and cotton waste, jute and jute manufactures, indigo and shellac. And large as the sum named above as the value of imports from India, it is probable that the real value of the Indian produce which finds its way to Hamburg is much larger, for a considerable part of these goods is still handled by London houses, being shipped from India to London, the owner or consignee disposing of them to the port offering him the best price, receiving payment in time to meet the drafts drawn against them. But the steamer bringing the Indian produce discharges it in London whence it reaches the consuming port by another line, and the country of origin of the Indian goods when they reach Germany is then considered to be the United Kingdom, Belgium, the Netherlands, &c. In exports from Hamburg, as in imports to the port, the United Kingdom is first with £21,982,782, the United States taking only £13,029,056, and Germany coming third with £11,850,633. The exports to British India were only £3,025,755, to Australasia, £1,717,678, and to British North America they shrank to £476,194, owing to what may be called the tariff war. A proof of the growing development of the trade and general intercourse between Hamburg and oversea countries, and in particular of British colonies and possessions, is to be found in the fact that in the course of last year several large banks which do business more especially with India, the Far East, South Africa, and Australia have established branch offices at Hamburg.

Shipbuilding holds a prominent place at Hamburg, and has, in a greater degree even than most other industries, developed during the last 25 years, owing to the enterprise displayed in all shipping undertakings, and the remarkable strides made in Germany in naval architecture and engineering. There are at present 11 shipbuilding yards at Hamburg, employing altogether about 9,000 hands. In two of the yards the largest class of ocean-going passenger steamers or war vessels can be built. The steady growth of the aggregate tonnage visiting Hamburg necessitates constant improvements and additions to the existing arrangements provided for the accommodation, and the discharging and loading, of sea-going ships and numerous descriptions of river craft which frequent the Hamburg harbour. The average annual amount spent in dredging inside and outside the docks (in the river) is about £40,000. During the decade 1890 to 1900 the average quantity of material dredged was 1,140,000 cubic metres per annum. The most difficult bars in the river Elbe have been successively deepened during recent years from 13 to 14 feet to 24 feet 6 inches, and this result is now to be further increased to 32 feet 8 inches, at an estimated outlay of £312,000. The project of building a tunnel underneath the river at Hamburg for providing a more convenient connection between the principal portion of the town and the many shipbuilding yards and other industrial establishments on the south side of the Elbe appears likely to be carried out at an early date. A Frankfort firm has offered to undertake the work of constructing the tunnel for £425,000, and it is probable that this offer will be accepted.

WOODWORKERS' SCHOOLS IN GERMANY.

There appears to be a consensus of opinion that schools for woodworkers in Germany have proved a great blessing to the people, for besides bolstering up the industries of the country, they add greatly to the artistic pleasure and development of the people themselves. Many of the carved objects attain a very high degree of art, and the cabinet work is as wonderful almost as the creations in painting, bronze, and marble. The best proof of the value of these schools, and their efficiency, is found in the fostering attitude manifested by the various Governments, and the encouragement given by men in the trade. It is interesting to note that most of the schools appear to have been established at times when, through unfavourable tariff conditions or adverse economic developments, the woodworking industry had been thrown into exceptionally straitened circumstances. To relieve the stress, resort was had to education. The first independent school for woodworkers in Germany started about the year 1859. Before that time, carpenters, cabinetmakers, and other woodworkers had to content themselves with theoretical instruction offered in the schools for builders themselves, as well as in the industrial art schools, some of the trade schools, and the largest continuation schools. These schools frequently had special classes for carpenters, cabinet-makers, turners, and other professional woodworkers. Some guilds in the wood industry also maintained similar courses. The difficulty with this system of instruction was that too much emphasis was placed upon drawing, and scarcely any on the practical features of the woodworker's trade. According to a special report recently issued by the United States Department of Commerce and Labour, which has undertaken an inquiry into the question of industrial education in Germany, the first step to supply this want of practical instruction was

taken in 1859, when, through encouragement by the Bavarian Government, the first German school for woodworkers was established at Berchtesgaden, in the heart of the great forest domains of Bavaria, and in the seat of the leading branches of the wood industry—an industry which had been developing for centuries. This school originated as a branch of the drawing school of Berchtesgaden, which was established in 1840. In this school four different courses of work are given—a preparatory course, an evening course, a Sunday course, and a graduation course. The efficiency of these courses is greatly increased by the equipment of the school with a good library, large collections of plaster, wood, and other models, drawing charts, graphic productions of art and industry, and ancient wood carvings. An exhibition is held every year from June to September, when the last work of the students of the school is displayed. Articles so exhibited are for sale, and are disposed of through a reliable salesman supplied by the school. As regards fees, no charges are made for residents of the city of Berchtesgaden; non-residents pay twenty shillings for six months tuition. With the school at Berchtesgaden as a successful precedent, there soon developed a number of similar schools, some of which added courses for cabinetmaking and turning, in addition to the work in carving. One was established at Bischofsheim, and others at Partonkirchen, Oberammergau, Neuhammer, Kötsling, Fürth, and Furtwangen. The school at Fürth is especially important, and was established to meet the needs of the three great industries which flourish there—cabinetmaking, carving, and turning. Another important school is the one at Furtwangen. It has two departments—one for cabinetmaking, the other for carving—with three classes in each department. The curriculum for the department for cabinetmaking is divided into a practical and a theoretical part. Great emphasis is laid upon practical employment to fix the theoretical instruction given from day to day as the studies progress. Aside from the schools already enumerated, which are in Bavaria, there may be mentioned as among the most important, the school for turners and wood carvers at Leipzig, the school for wood carvers at Warmbrunn, Silesia, the school for cabinet making and wood carving at Flensburg, and the school for carpenters at Berlin. Numerous other schools of this class, of greater or lesser importance, are also found distributed here and there throughout the country, as the needs of industry have seemed to call for their establishment. Related to the school for wood carvers are the schools for basketmaking, such as are found at Heinsburg, in Prussia, and Lichtenfels, in Bavaria, which two institutions are among the leaders in this class. Schools for straw plaiting are to be found in different parts of the mountainous regions of Germany. The first was established in the Odenwald in 1845. Others soon followed in Saxony, and in the Black Forest, where the manufacture of straw hats has been carried on for centuries. It is interesting to note, in connection with the work of the woodworkers' schools, that the Tyrol, the Black Forest, Odenwald, and Thuringian forest lands are under very great obligations to them. Oberammergau owes a large part of its artistic powers to the development of its woodworkers in schools such as are here outlined. For a long time the Black Forest clock industry was threatened with extirpation. Competition with machine-made clocks was rapidly undermining the Black Forest factories. The schools of Furtwangen and in the Tyrol put it in the power of the Black Forest and the Tyrol people again to enter the world's markets, and to maintain a position therein. The beauty of the woodwork with which their clocks are now ornamented has made them great favourites in all parts of the world. Without the carved woodwork, it is a question whether the German or Swiss clock industries could continue to exist.

SANITATION IN BRITISH INDIA.

There are few matters in regard to which national ideas differ so radically as they do in regard to cleanliness. Men of one race, even of component nationalities in the same race, have very different standards. To define the differences which exist is not an easy matter, but it may perhaps be said that whereas the high caste Indian and the upper class Englishman has each a high personal standard, the one incomprehensible to the other, the essential difference lies in the recent English recognition of the necessity for a communal standard of cleanliness whose benefits shall not be personal but municipal or even national.

The Report on Sanitary Measures in India,* issued at the end of last year, is unknown even to many workers along these kindred paths in Great Britain. Its scope is a fairly wide one, and it deals with widely diverse concerns such as the health of the Army (British and Native), the terrible spread of plague, effects of vaccination, and general sanitary methods. Much of what is written therein is of purely medical interest, in particular that section which gives the history of the chief diseases. Of more general interest are the reports from the sanitary boards of the various provinces, whose activities are diverted into a number of channels. For instance, in Calcutta, the removing of clusters of native huts has been carried on as in preceding years. Progress was made in the extension of the filtered and unfiltered water supply. The length of the mains supplying filtered water is about 317¼ miles, and the total mileage of unfiltered water pipes 172¼ miles. The municipalities in the interior of Bengal spent £150,300, or 43·41 per cent. of their income on sanitary works during the 1901-2 financial year. The Bengal Sanitary Board has authorised

* No. Cd. 2298. Eyre and Spottiswoode. Price 1s. 6d.

the Muzaffarpur municipality to construct a septic tank. In the United Provinces of Agra and Oude, many improvements in various directions were carried out in the municipalities and smaller centres of population. Important drainage works are in course of construction at Allahabad, Cawnpore, Lucknow, Benares, Farrukhabad, and Aligarh, which "should prove of great utility in improving the public health of the country." In the Punjab the chief works which have been carried out were the Amritsar water works, the Simla sewerage extension works and drainage of the bazaars, the extension of the Lahore water works distribution system, and water and drainage works at Lyallpur and Ambala. The Delhi water works have been completed, and the city is now adequately supplied with pure water.

No large works were undertaken in the North-West Frontier Province, attention being mainly given to the cleaning and improving of wells and tanks. The water supply of Peshawar, Burma, and Bannu being extended or improved. From the Central Provinces, Assam, Burma, Madras, Bombay, and Berar similar reports are presented, and special note may be made of the report from Bombay. Good progress was made with the drainage work in Bombay city, but of the province as a whole, the Sanitary Commissioner says that "real sanitary progress has been at a standstill for some years past, on account of the plague epidemic, which shows no signs of abatement." No progress was made in the introduction of the Village Sanitation Act, owing to the prevalence of plague and famine, which have absorbed the attention of district officers in recent years.

The book as a whole is full of material of medical and social interest, giving, as it does, details not only of pathological matters, but also of matters of municipal administration.

THE FRUIT INDUSTRY.

The Report of the Departmental Committee appointed by the Board of Agriculture and Fisheries to inquire into and report upon the Fruit Industry of Great Britain, is a very able statement of the position and prospects of that industry. The evidence collected by the committee is of great value, and the conclusions drawn from it are likely to meet with general acceptance. In the selection of witnesses, the committee endeavoured to procure thoroughly representative men by inviting various corporate bodies and local authorities to delegate one of their members to give evidence. Besides hearing evidence, the committee visited some of the chief fruit-growing districts in England, and they submit a series of recommendations which will, no doubt, result in certain changes in existing law and practice. According to official statistics the total acreage under orchards in 1904 was 243,008 acres, of which 236,705 were in England, 2,490 in Scotland, and 3,813 in Wales. These figures refer to orchards only, not to small fruit, though in many cases there would be small fruit under the orchard trees. Taking the figures by counties it will be found that six counties comprise three-fifths of the orchard acreage of Great Britain—namely, Kent with 29,055 acres, Hertfordshire with 28,042 acres, Devonshire with 27,346 acres, Somersetshire with 25,265 acres, Worcestershire with 22,387 acres, Gloucestershire with 20,385 acres. Hertfordshire has the largest acreage in proportion to its size of any county, no less than six per cent. of the cultivated land being orchard; Worcester follows next with 5·4 per cent., and Kent stands third with 3·7 per cent.

Turning next to small fruit, the total acreage in 1904 was 77,947 acres, 70,612 acres being in England, 6,072 in Scotland, and 1,263 in Wales. In this case one county—namely, Kent—is far ahead of any other, having no less than 22,549 acres. Next comes Middlesex with 4,700 acres; then Worcestershire with 4 546 acres; then Cambridgeshire with 4,403 acres; then Norfolk with 4,030 acres; then Hampshire with 2,472 acres; then Essex with 2,061. No other county reaches 2,000 acres of small fruit; but whilst this acreage represents only a small proportion of the cultivated land in Great Britain, the fruit industry appears to be a very progressive industry. Taking orchards, there has been an increase from 148,221 acres in 1873 to 243,008 acres in 1904, or 63·9 per cent. in 31 years. Taking small fruit, there has been an increase from 69.792 acres in 1897 to 77,947 acres in 1904, or 11·7 per cent. in seven years. With this remarkable growth it is instructive to compare the decline of every other crop in Great Britain. There has been a decrease in the acreage of wheat from 2,564,237 acres in 1888 to 1,375,284 acres in 1904, or 46·3 per cent. in 16 years; a decrease in the acreage of all corn crops from 8,187,758 acres in 1888 to 6,953,034 acres in 1904, or 15 per cent. in 16 years; a decrease in green crops from 3,471,861 acres in 1888 to 3,036,026 acres in 1904, or 12·5 per cent. in 16 years; a decrease in hops from 58,494 acres in 1888 to 47,799 acres in 1904, or 18·2 per cent. in 16 years.

What is the explanation of this remarkable increase in fruit cultivation? It is to be found in the extraordinary growth of the taste for fruit on the part of the public. Fruit is becoming more and more a regular article of food for all classes, and, except in special years of glut, the home supply has not kept pace with the demand. Nor is it only the consumption of fresh fruit which has largely increased. There is a great and growing demand for jam, preserved fruits, and even cider. As regards cider, there was a falling off for many years both in the public taste for it and in its manufacture, due largely to the deterioration of the great vintage orchards in the West of England which, planted in the seventeenth century, had seldom been replenished. In the last ten years, however, renewed attention had been paid to the industry, a considerable amount of planting has taken

place of cider varieties of apples, especially in Herefordshire, and organised efforts have been made, with considerable success, to revive the trade.

That the extension of the fruit industry is a benefit to the country, and should be encouraged by all proper means, is demonstrable. As the committee point out, fruit has taken the place of wheat where it has been found impossible to make wheat pay, and the profits from fruit growing, taking one year with another, are far greater than those from ordinary farming. The committee say that when visiting the Evesham district they saw land which was let a few years ago for ordinary agricultural purposes at not more than £1 an acre, and is now fetching £6 an acre as a fruit plantation. Evidence of similar advancement of value was given the committee from Middlesex. Open land in the county is to be found for which the rent is £3 an acre, while on the other side of the hedge there is similar land for which the tenant is paying £10 an acre, simply because it is under fruit. And of course with the advancement of rent comes an increase in selling value. Again, the planting of fruit means great additional employment of labour in country districts. A fruit plantation employs far more labour than any other crop with the possible exception of hops. If the evidence of Mr. Wood, of Swanley, is to be accepted, and he is a grower not only of fruit on a very large scale but also of hops, fifty acres of fruit land properly cultivated costs more money in labour than 1,000 acres of ordinary corn land, and Mr. Wood put the average labour bill down at £25 an acre per annum both in the case of fruit and hops. The committee believe that "no better means can be devised for bringing people back to the land than an extension of the fruit industry where it can be done profitably. Nor is this all. It should be remembered that besides the regular labour employed all through the year a great amount of extra labour is required during the picking season which, in the case of fruit, lasts for three months, and this labour is obtained chiefly from London and other large towns and industrial centres, thus providing a special opportunity for many of the workers in other places of enjoying a most healthful and profitable change into the country." There is abundance of land where fruit growing might be profitably undertaken.

Not that it is all plain sailing. The industry has to reckon with difficulties and drawbacks many of them of a serious character. The committee summarise these disadvantages and some of them may be given here. (1) There is insufficiency of knowledge as to the right kinds and varieties of fruit to plant, the character of the soil, the effect of manuring, pruning, and general treatment, diseases and insect pests, packing and grading; (2) it is difficult to obtain land for the cultivation of fruit with equitable adjustment of the respective rights of landlord and tenant; (3) there is often unfair valuation of fruit holdings for the purposes of local rates and imperial taxation; (4) the fruit grower has cause of complaint against the railway companies, excessive rates, preferential rates, unpunctual deliveries, bad handling, pilfering, inadequate service, and refusal to pay claims; (5) foreign competition and tariffs hostile to British fruit; (6) indifferent inspection of foreign fruit; (7) the difficulty of obtaining labour in country districts; (8) the insufficiency of markets and other market grievances; (9) the ravages of birds. The committee deal with all these complaints and for the most part reach the conclusion that they are well founded. Readers are referred to the report itself for detailed reference to these matters. Here may be given the chief recommendations and suggestions made by the committee.

They recommend that a special sub-department of the Board of Agriculture and Fisheries be established to deal with matters connected with the fruit industry, and that there be two branches of such department, (*a*) a bureau of information, (*b*) an experimental fruit farm: that horticulture be taught in elementary schools in country districts, and that such schools should have school gardens attached wherever possible; that the Market Gardeners' Compensation Act be amended by making Section 4 retrospective; that when a tenant gives notice to quit he shall not be entitled to receive compensation unless he presents to the landlord a successor who is willing to take over the holding at the same rent; that in the event of his so doing, and the landlord accepting his nominee, the compensation be paid directly by the new tenant to the old tenant, but that the landlord have the right to refuse to accept the outgoer's nominee, in which case he must pay compensation to the outgoer under the provisions of the existing law; that the State be empowered to lend money to landowners who have fruit on their estates, subject to certain conditions, for the purpose of supplying the ready money required for the payment of compensation at the determination of a tenancy; that a Bill should be passed for facilitating the purchase of small holdings by tenants somewhat on the lines of Mr. Jesse Collings' Bill of last session; that in the assessing of agricultural holdings for local rates, the assessment should not be raised by reason of the planting of fruit for a period of five years after the planting in the case of small fruit, or seven years in the case of mixed plantations, and twelve years in the case of orchards; that a more simple and uniform system of rates for fruit be introduced by the railway companies, and that they should make greater efforts for ensuring the prompt delivery of perishable fruit; that jams made wholly, or in part, from foreign fruit be labelled, and the Government should undertake the inspection of imported fruit and fruit pulp at the ports of entry; that the present by-laws for building in country districts be modified so as to allow of the cheaper construction of cottages; that fruit growers should pay more attention to the careful packing and grading of better class fruit, and the selection of the right kinds of fruit to plant according to the soil, and to the importance of cultivating fewer varieties, especially of apples. It will be seen

that the recommendations of the committee, of which only some of the most important are named above, are many and various. Perhaps one of the most striking facts brought out by the evidence taken by the committee is the growth amongst fruit growers of what may be roughly called the "Ulster" custom. Under the provisions of the Market Gardeners' Compensation Acts, a tenant of a holding, which it is agreed in writing shall be let or treated as a market garden, may plant fruit, and erect the necessary buildings without having first to obtain the consent of his landlord, and at the end of his tenancy is then entitled to compensation which often amounts to a very large sum an acre. In the Evesham district, it is the almost invariable custom for the outgoing tenant to find an incoming tenant who buys him out, the landlord neither paying nor receiving any money, and rarely objecting to the outgoing tenant's nominee, the fact that he is able to pay out his predecessor being a sufficient guarantee of his financial position. This custom is not easily distinguishable from "tenant right" in Ireland, which successive Governments have sought to abolish by giving the tenants great facilities for purchase of the fee simple.

IRON ORE DEPOSITS IN FOREIGN COUNTRIES.

The reports on iron ore deposits in foreign countries compiled at the Board of Trade from information collected by His Majesty's Diplomatic and Consular officers, and just issued, have been made in response to a request of the British Iron Trade Association. The Association asked Lord Lansdowne to obtain information as to the extent and character of iron ore supplies in foreign countries, and the particulars sought were described in a series of questions which the officials to whom they were addressed were desired to answer "directly and precisely." The result is a bulky volume containing much that should be of use to the interests concerned.

The two greatest coal-producing areas of the world are those to be found in the State of Pennsylvania and the province of Shansi in China. The area of Pennsylvania is 43,960 square miles, containing 20,000 of coal land. The area of Shansi is 55,000 square miles, and Professor Dana thinks it probable that "it will take the palm from Pennsylvania by a considerably more favourable proportion." In 1891 the only mine in Pennsylvania which produced as much as 100,000 tons per annum was the Cornwall mine from which magnetic iron supplies were obtained. The State of Pennsylvania in 1890 made 48 per cent. of the pig iron production of the United States, declined to 46·2 per cent. in 1900, and further dropped to 45·5 per cent. in 1902. These declines, however, were almost entirely confined to the eastern part of Pennsylvania, whilst in the western part there have been almost proportionately large advances, but lake ores were used entirely. In Shansi the coal can be extracted with greater ease and cheapness, but this great coal and iron region labours under two serious disadvantages. Firstly, it is situated a distance away from the coast, and from rivers that are fit for other navigation than by small Chinese boats; and, secondly, the whole of the coal formation rests, as it were, on a platform raised some thousands of feet above the adjoining plain. The steep ascent from the latter offers great difficulties to the construction of a railway, which will be the only means of ever bringing to account the mineral wealth of Shansi.

At the request of the Governor of Utah, Mr. A. C. Milner, of Salt Lake City, drew up a valuable report on the coal area of that State, and forwarded it to the Consul-General for the purposes of the present compilation (page 244). The iron deposits are situated in South-Western Utah, in Iron Mountain and Iron Springs districts, which are about 22 miles south-east of the Oregon Short Line railroad. These deposits cover an area of 15 miles long by about three miles wide, the ore showing on the surface at three different points. It is principally a soft red and brown hematite, which can be handled easily by steam shovel, except where blow cuts occur, which are hard and magnetic. Hundreds of acres will require only from one to three feet of stripping. Ore can be stripped, mined, and put on cars for 15 cent. per short ton (2,000 lbs.). Various experts who have made examination of these properties state that this is the largest surface of iron ore in the world. The tonnage in sight is so great that it is very difficult to state what it is, but the experts have made estimates from 100,000,000 to 500,000,000 short tons. About 25 per cent. of the ore is Bessemer, the balance being basic. The ore runs an average of about 60 per cent. metallic iron. The average in silica is about 7 per cent. The limestone adjacent to the iron has all proper fluxing qualifications necessary in furnace work. The iron-fields are 273 miles from Salt Lake City, and 445 miles by Clark Road Survey from San Pedro Harbour, which is the Pacific Coast terminus of the Clark Road.

The United Kingdom relies largely upon Spain for the supply of iron ores, and from 70 to 80 per cent. of the shipments from the three provinces of Viscaya, Guipuzcoa, and Santander are consigned to this country. Spain does all in her power to encourage the exploitation of her mineral wealth by foreigners, who are on a complete equality with natives in taking out claims for mines. The Bilbao ores are sold on a 50 per cent. basis of metallic iron, and in many cases a proportion of inferior ores is shipped with those of good quality in order to keep the average analysis to the above percentage. Very much depends, naturally, in such cases on the care used in the mining and picking, as well as on the state of the weather during extraction and shipment, a most important consideration. The qualities of ore presumed to be still in deposit were put down in 1897 at forty or fifty million tons in Biscay, but over thirty million

tons have been worked out since then. The indications of exhaustion, however, appear, according to Mr. Consul Ward, to be still similar to those on which calculations were based eight years ago, judging from the fact that the exploitations and shipments still nearly keep up to the level of previous years, *i.e.*, at the rate of about four or five million tons annually. There is little doubt, in the Consul's opinion, that new mines as well as old ones make up among them for the lesser quantities produced by the failing or already exhausted ones. Engineering is an exact science, but how far experts in it may be trusted when they take to divination no one can safely say. The latest expert opinion puts the available iron ore in the actual mining district of Bilbao at 50,000,000 tons.

Amongst what may be called undeveloped countries Abyssinia is believed to be exceptionally rich in iron ore, but under present circumstances, as Mr. Clerk points out, the difficulties of obtaining a concession on fair terms, the enormous cost of importing machinery and exporting the ore, and the comparatively small demand for iron in the country itself, would entail a heavy deficit for many years on any company that undertook to work the mines. Moreover prospectors of various nationalities have visited nearly the whole country, and the mineral rights of those districts which show most chance of paying have already been taken up by groups of concessionaires. All land belongs to the Abyssinian Government, and no proprietary rights would be sold. Working rights for a limited number of years might be obtained. All working is very primitive: no shipments have ever been made. If, says Mr. Clerk, the Emperor Menelik supports the mining company, the chief difficulty would be removed. But there would probably be, especially at first, endless minor difficulties, and such a company must remember that it is entirely dependent on the caprice of the Government of the country. Only a competent mining engineer could give a proper estimate of the prospects of iron mining in the regions of Abyssinia not already given to prospectors or concessionaires. "My own untechnical opinion," writes Mr. Clerk, "is that until transport is cheaper and the country more educated, to attempt to work the iron here would be a dead loss; the only reason for applying for a concession would be to forestall others. To do so a capitalist, or a syndicate, must be prepared to lose money for many years in the faint hope of an eventual profit."

In 1902 there were working in Sweden 332 mines, which yielded an aggregate of 2,896,208 tons of iron ore (viz., 2,615,533 tons of magnetite and 280,675 tons hematite ore), valued at £798,181. Labour-saving machinery is utilised as much as possible. Rock-boring machines, either pneumatic or electrical, are in use, the electric power for them and all other requirements being generated at the mines and transmitted from a power-station in the neighbourhood. In no civilised country is there less willingness to encourage foreigners to engage in mining operations. A foreigner is not allowed to hold either land nor mines, or, since 1895, to act as a director o public companies in Sweden without special permission of the King. In the Articles of Association of the body controlling the business of export companies it is agreed that the shares cannot be registered in the name of a foreigner. Mining properties are occasionally offered for sale to foreigners, but such proposals, says Mr. Consul McGregor, should be treated with the greatest caution on account of the difficulty of obtaining the necessary title. In Russia the largest and most important deposits of iron ore are to be found in the Krivoi Rog region. The ore bed lies along the rivers Saksagan, Ingulez, and Jeltaya, in the form of a narrow strip, for a distance of about 40 miles. When the ore was first worked the rent of the land was only about 4s. per acre, but with the development of the industry rents rapidly rose, and towards the end of the nineties 1s. 4d. to 2s. per ton was freely paid, eventually reaching 4s. per ton, in some instances being coupled with guarantees of minimum annual payments of £8,000 to £12,000. The latter works out at about £75 per acre per annum. Of the total output of iron ore in South Russia, 94 per cent. falls to the share of Krivoi Rog, 3·5 per cent. to Kertch, and the remaining 2·5 per cent. to Donetz ores. Under an Imperial decree of May, 1898, all foreigners are prohibited from acquiring by purchase, or otherwise, in certain districts of the Caucasus, any lands situated outside the limits of towns and settlements, except under special certificates granted, in each separate case, by the Governor-General of the Caucasus.

Iron ore is said to exist in almost every part of Madagascar, but it is worked only in the Central Provinces. The quality is poor. As coal has not been found in the island as yet, and roads are almost unknown, the natives are obliged to remain in the vicinity of forests where the iron ore is smelted by rudimentary means. Transport to the nearest port, Andevorando, would co t rom £10 to £14 per ton. In the Philippine Islands, extensive deposits of iron ore are known to exist, but their development must be preceded by the development of the coalfields. There are now some 1,200 prospectors and practical miners scattered through the different islands of the Archipelago, most of them American. So far, no European trade in iron ore has been carried on in German East Africa, but there are three localities which, it is thought, might be exploited with satisfactory results. In Morocco, there are numerous iron ore deposits, but down to the present all prospectors have been regarded with great suspicion, and consequently no scientific investigations have been possible. The liberality of the Spanish law —which does not seem to have been altered since the war—in Cuba is noticeable. No export tax has ever been paid, and import taxes on materials have been light, and at times *nil*. Nor has the man who located the mine had to pay anything beyond a

moderate fee for measuring and registering, and once in his possession he has not been asked to pay any further tax however long the mine might remain in his possession without his working it.

LIQUID FUEL FOR STEAMERS.

Liquid fuel is now largely used by the Dutch steamers of the Koninklyke Paketvaart Maalschappij (Royal Packet Company) plying between the different islands of the Netherlands Indian Archipelago. It is residue from the petroleum wells in Netherlands, India, the greater part being from the Asiatic Petroleum Company's wells in Borneo. The total consumption of the liquid fuel by the Royal Packet Company's steamers, according to the American Consul at Batavia, amounted to 11,700 tons in 1902, and 16,500 tons in 1903, while in 1904, the estimated consumption was 26,000 tons. The company has contracted for a supply for the years, 1905 to 1907, with the Asiatic Petroleum Company, to the extent of 32,000 tons per annum. The ton is calculated at about 265 gallons. The fuel sells at about thirty-two shillings per ton, but it is understood no such price is paid by the Royal Packet Company when contracting for large quantities. At the present time, there are seventeen of the company's steamers using liquid fuel, and it is found much more economical than coal, better for the boilers, cleaner in every way, and fewer men are required to work the furnaces.

Credit is given to the Superintendent-Engineer of the Royal Packet Company, for inventing a system of injecting the liquid fuel into the furnaces of the steam boilers. The fuel is brought under a pressure of from ten to twenty pounds to the square inch and evaporated by a somewhat modified "Korting's" burner, without use of steam. This apparatus works very satisfactorily, without noise and without the loss of fresh water. Formerly the liquid fuel was injected into the furnaces by means of a steam jet, making very much noise, a great inconvenience, annoying to the passengers and causing the loss of much fresh water in the form of steam. A suitable furnace arrangement guarantees proper and perfect burning of the fuel, so that very little smoke escapes from the funnel, steam is kept regularly at the same pressure during the voyage, and the boiler is kept as a uniform temperature, thus preventing much trouble from leakage and other damage. Liquid fuel was first used by the Royal Packet Company in 1898, and as it has been found satisfactory, all new ships built in the Netherlands have been furnished with proper boilers for the use of this fuel, and many of the older boats have had the necessary change made. It is therefore, it is said, only a question of time, when all the steamers of the company will use liquid fuel.

OBITUARY.

JOHN PRATT.—The death at Chattanooga of Mr. John Pratt, the inventor of a very early form of the typewriter, has recently been announced. In 1867, Mr. Pratt read a paper before the Society, "On a Machine for Typewriting," and exhibited one of the apparatus invented by himself. His paper will be found in the number for May 3rd, 1867. The apparatus is described in full detail in his paper, and a shorter description is given in the *Journal* for the 18th of February, 1876, drawn up from one of Mr. Pratt's machines which was then in the possession of the Society. The machine was not at that time in working order, some of the parts having been broken, but it was still capable of producing work.

The types are all fitted on the face of a small plate, about three-quarters of an inch square. This is supported vertically before a frame carrying the paper by an arrangement of levers capable of giving it both a vertical and a horizontal motion. By a proper combination of the two movements, the plate can be shifted into any position, and consequently any type required can be brought opposite the point where the impression is taken. As this is done, the same mechanism which moves the plate sets in motion a small hammer, which strikes on the paper on the opposite side to the plate, and strikes the paper against the type, thus producing an impression. Carbon paper is, of course, used in this as in the other machines above mentioned, and therefore several copies can be taken. In order to limit the number of keys required to operate the levers for shifting the type-plate, the inventor had one set of keys for giving the vertical movements, and another for giving the horizontal movements. Thus, for each letter it was required to move two keys, but as each key of one set could be used with each key of the other set, a much smaller number of keys was required than if one key were required for every letter. It may make it appear clearer to say that the depression of one key brought into position the vertical line containing the type required, this depression of the other, the horizontal line containing the same type, and consequently the intersection of the two lines, where the special letter needed was to be found, was brought into the proper place for the impression. Then, if K be the number of keys, T the number of types, it is obvious that $K = 2\sqrt{T}$, *e.g.*, for 64 types 16 keys would be wanted. The paper was carried in a small frame, traversed after each letter by a rachet-wheel and pall. At the end of a line the frame was raised by a rack worked by a separate key, and at the same time thrown back to the proper side of the machine for commencing a fresh line.

Mr. Pratt's machine was patented in Great Britain and in America, and there is still in the Patent Office at Washington a typewritten letter which accompanied the model deposited with his application for a patent.

He was born at Unionville, South Carolina, in 1831, and for a good many years he practised as a lawyer and a journalist in the Southern States. At the time of his reading the paper he was resident in Alabama. He afterwards lived in Brooklyn, but he had resided in Chattanooga some two years before his death. It was only last year that a renewed communication with him led to his becoming a member of the Society, to which he had contributed a paper, now of considerable historic value, nearly forty years before.

GENERAL NOTES.

AMERICAN BEET SUGAR.—In 1897 the State of New York commenced the manufacture of beet sugar, but the experiment has not been a successful one. In that year a law was passed for the promotion of the culture of sugar beet, a bounty of not more than one cent per lb. being given for sugar made in accordance with the requirements, and about £5,000 was appropriated for the purpose. Factories were to obtain a distributive share of this appropriation, provided that all the beets they used were grown in the State of New York, that they did not grow their own beets but paid not less than £1 per ton for them, and that the sugar they produced contained not less than 90 per cent. of crystallised sugar. The policy declared at the time was to make direct appropriations from the State for a successive period of not less than five years in aid of the permanent establishment of the beet-sugar industry in the State. The bounty was first paid at a maximum of ½d. per lb., and the appropriations increased from £5,000 in 1897 to £20,000 in 1901, but in the following year the appropriation was reduced to £10,000, and the bounty was also cut down to ¼d. per lb., at which figure it remains. In 1897 a factory was set up at Orme, New York, the machinery being imported from Canada; in 1898 a second factory was established at Binghamton, and in 1899 a third factory at Lyons. These, says Consul-General Sir P. Sanderson, from whose report (No. 3353, Annual Series) these facts are taken, seemed to do well at first, and the central part of the State appeared to be well adapted to the cultivation of the sugar beet, but the industry made little progress. In 1900 the factory first established went into liquidation, the causes given being insufficiency of capital and difficulty in obtaining beets, and in 1904 the Binghamton factory removed to the State of Idaho, so that at the present time there is only one factory in operation in the State of New York. The approximate amount of beet sugar manufactured in the State in late years has been in 1899, 3,600 tons; in 1900, 6,000 tons; 1901, 4,050 tons; 1902, 2,800 tons; 1903, 4,400 tons; 1904, 3,200 tons; the ton in each case being reckoned at 2,240 lbs.

SAMOA PRODUCTS.—In his report upon the trade of Samoa for 1904 (3380 Annual Series), Mr. Acting Vice-Consul Trood speaks of the profits to be derived from cacao and cocoanut plantations. The cacao plantations, small and large, are all doing well, but a good crop is not to be got in less time than five years from the time of planting, and meantime the trees require much care and attention. On this account small proprietors are at a disadvantage since they are not only unable to acquire labour as easily as the large plantations, but often find it difficult to raise money to pay for labour when they get it. Consequently in this case trees which would produc heavy crops in five years' growth on the large holdings, bring little return to them for seven or eight years. Not less than £2,500 are required to start a cacao plantation, the cost per acre from clearing the land to the gathering in of the first crop being put at £25 to £30. But a cacao plantation pays handsomely once it gets into full bearing. Mr. Trood instances a small plantation 20 miles from Apia to the westward — started four years ago — which yielded its proprietor at the end of 1904 6,000 lbs. of cocoa from eight acres, worth in Apia, 6d. per lb. As regards cocoa plantations, the trees in Samoa scarcely ever suffer from disease, and not one tree in a thousand is blown down by a hurricane, while however severe may have been the cyclone the trees are not affected by it for more than 21 months afterwards, and then yield a larger crop of cocoanuts than they did before the gale. They offer further advantages as regards the pasturing of cattle under them which can be turned in amongst the trees as soon as they are of eight years' growth. The cost of making a plantation of, say, 200 acres of cocoanuts (and no plantation of a smaller size, Mr. Trood says, would bring in even a moderate income) cannot be reckoned at less than £30 to £40 per acre.

THE TRADE OF NORWAY.—Probably Christiania is the only European capital whose population actually declined in 1904, and whose assessment was lower than in 1903. The population of the Norwegian capital lessened by about 1,303 souls, and there was a decrease in the assessment of 5·15 per cent. on property, 4·26 on incomes, 6·05 on taxable income, and 1·10 on trade taxes. These figures, however, represent only the original assessment, which is subject to many reductions amounting to as much as 16 per cent. of the assessed amount of the trade tax for the year. In his report just issued (No. 3425, Annual Series), the Consul-General, Lord Melville, gives particulars of the number of commercial travellers' licenses issued by the Christiania police authorities in 1904. They numbered all told 1,401, including 354 licenses issued in other places and visèd in Christiania. Of these 1,401 no fewer than 803 were German and only 132 British, and this notwithstanding that the number of German residents trading in the country is far more numerous than the British. One would have supposed, says Lord Melville, that the greater number of Germans engaged in business up and down the country would have rendered so large a number of travellers from the Mother Country unnecessary. The inference seems to be that a large number engaged in business in the country is not all sufficient. Emissaries must be sent that no chance may be lost of finding a market, and personal solicitation is more effective than letter and catalogue. Lord Melville says that "on the whole" British goods find favour "if the price is in accordance with the national means," but "more push is required."

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NOTICES.

EXAMINATIONS.

The results of the Advanced Examinations (Stage III.) have just been published, and copies sent to all centres for distribution to candidates.

The results of the Intermediate Examinations (Stage II.) will be published about the middle of August, and those of the Elementary (Stage I.) towards the end of that month or early in September.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

INTERNAL COMBUSTION ENGINES.

By Dugald Clerk, M.Inst.C.E.

Lecture IV.—Delivered March 6th, 1905.

SYLLABUS.

Future Developments.—Petrol engines—Suction producers—Blast furnace gas—Producer gas in power stations—Air supercompression—Exhaust supercompression—Marine gas and oil engines—Line of advance.

No lectures on internal combustion motors would be complete without some reference to petrol motors. Gas engineers have learned much from the petrol motor, and from the very able Continental and English engineers who have devoted themselves to this subject. They have produced most serviceable and powerful little motors, running at speeds of rotation which would have been deemed commercially impossible even ten years back. Among these motors, as among large engines, the battle of the types continues, and ultimately each purpose will develop its standard type. Indeed, at present petrol motors are rapidly approximating to standard conditions. This was very noticeable at the recent exhibition at Olympia. Most of the engines were of the inverted vertical type.* Even Lanchester, the most original of all inventors in this field, has at last conformed to the general trend. Many excellent horizontal engines, however, are in use; and a test was recently made for me at the Wolseley Works, Birmingham, on a 6 horse-power horizontal Wolseley engine, by my colleague, Mr. M. A. Adam, B.Sc. In this test there was taken brake power, petrol consumption, and the calorific value of the petrol used. Indicator diagrams were also obtained by the Hospitalier Carpentier instrument. The indicated efficiency found in this test was 19 per cent., the ideal efficiency for an engine having the same compression, *i.e.*, $\frac{1}{4}$, being 43 per cent.

I must, however, leave the subject of petrol motors to discuss three important developments of the gas engine industry, viz., suction producers, blast furnace gas, and producer gas distributed from central stations.

The suction producer is already well established, and many hundreds of installations have been set to work during the past year, and are now operating with great success. The advance in the suction producer promises to be even more rapid, and I think that very much power will thus be developed and supplied at an economical rate. Blast furnace gas also offers a very important source of power: at least a million horse-power can be continually produced from the blast furnaces which are at present at work in this country. This enormous force is as yet hardly touched. There is actually about a million horse-power in the shape of gas going practically to waste from the iron furnaces of the country, and

* Lantern slides and photographs illustrating the following were shown:—Siddeley petrol motor; Wolseley petrol motor; Walthamstow Electric Lighting Station producer plant; Mond Gas Company's Staffordshire Station; Cockerill engine working with Mond gas at Messrs. Richardson, Westgarth and Co.'s Works, Middlesborough; Napier motor boats; marine motors and boats built by Messrs. Thornycroft.

that is one of the great developments of the future which is being tackled, and the difficulties have been overcome to a certain extent. Much remains to be done. Central stations for producing and distributing fuel gas are also in prospect, and one large installation will be started within a few weeks.

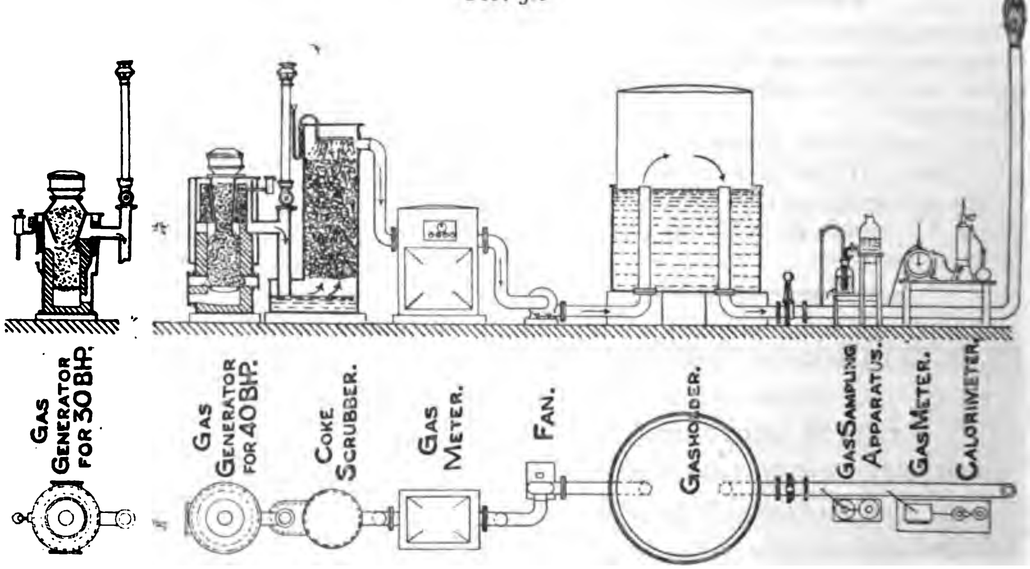
I will shortly consider these three matters in turn. Beginning with the suction producer, Fig. 31 shows a vertical section and plan of the Dowson suction producer arranged for an efficiency test, a separate generator being shown on the left. In the original Dowson pressure producer a fire is lit within a firebrick casing, and a mixture of air and steam is blown under the grate and into the fire by means of a steam jet from a steam boiler, the steam jet inducing an air current. The air and steam mixed pass through the anthracite and decompose the fuel; that is to say the steam is decomposed and the carbon combined with the oxygen of the water and the oxygen of the air, forming carbonic oxide gas, as represented by the formulæ—

$$C + O = CO \quad .. \quad .. \qquad (1)$$

$$\text{and } C + H_2O = H_2 + CO \; .. \qquad (2)$$

Steam cannot be decomposed without the addition of heat, but steam in the presence of red-hot carbon, or a little more than red-hot carbon, will decompose, and carbonic oxide and hydrogen are obtained, but this action absorbs heat. The combustion of the carbon as set out in the first equation gives out heat which is utilised according to the second equation to break up the steam. The function of any producer, however, of the pressure or suction type is to utilise the heat from the combustion as much as possible so as to give, instead of the solid carbon in the anthracite, a mixture of gaseous fuel, carbonic oxide, and hydrogen, with diluting nitrogen, in order to give a fuel suitable for introduction into the gas engine or internal combustion cylinder. Theoretically, that transformation from the solid carbon by means of air and steam can be made without loss, but practically there is always some loss. If it were possible just to keep the furnace at the temperature at which all the heat that left the furnace would be taken up for heating the entering steam, it would be possible to get a reaction which would give 100 per cent. of the heat in the form of cold gaseous fuel ready for the gas engine; but there is always a ratio of imperfection or inefficiency, and in the pressure producer the usual proportion of heat converted into gas ready for the engine is about 75 per cent. to 80 per cent.; that is, 100 heat units given from solid anthracite give 75 or 80 units in the form of carbonic oxide and hydrogen in the pressure plant; 75 per cent. to 80 per cent. is a better result than is obtained in most steam boilers; but in the suction gas plant even better results can be got. My colleague, Mr. Adam,

FIG. 31.



DOWSON SUCTION PLANT.

made a test of a Dowson suction plant some months ago, with the object of finding out the exact number of heat units of the fuel converted into gas which was ready for use in the engine, and he found, as the result of nearly a fortnight's testing, that every 100 heat units put into the suction producer at Dowson's Works gave out a matter of about 90 heat units, in the form of gas suitable for use in the engine. In the pressure producers, a steam boiler or a blower has to be used, and water has to be evaporated to go in with the air, and to decompose the steam and air by means of incandescent fuel. In the suction producer all that is done away with. The producer is started by a small fan worked by hand for about ten minutes, the whole of the mass of anthracite becoming incandescent. Water is supplied continuously, and is vaporised and drawn in by the air passing through the producer. At the start the hand fan is blowing gas right through the apparatus, and to a cock near the gas engine to make sure that the engine is getting a proper gas supply. When the gas becomes rich enough, the fan is stopped, and the engine is started in any usual way, and then begins to draw gas through the producer in exactly the quantity required for its operation, no fans or blower being required. The mixture of steam and air sucked in through the producer gives carbonic oxide, hydrogen, and a little light hydrocarbon. The gas formed, with nitrogen from the air, goes to the scrubber, where it passes through coke over which a constant stream of water is pumped. The gas passes through a little sawdust to take any final tar out before it reaches the engine. This arrangement is found to be exceedingly effective, and it is coming into use very largely all over the world, because it has a very high efficiency, and there is no danger attached to it. There is no danger of poisonous or inflammable gas. The gas in the producer is in the pipes, and always at a pressure a little below atmosphere, because it is being sucked into the engine by the motion of the engine itself, giving an extremely handy and simple producer in a form that anyone can work, however unskilled. The producer may be placed in comparatively confined spaces, and without any danger of gas poisoning, which was one of the dangers of pressure producers, and consequently, all over the world these suction producers are coming into use. Taking the ordinary price of anthracite delivered—in the tests which Mr. Adam made it was 24s. a ton—and taking a National engine of 40 horse-power, the price works out for 1 horse-power hour at rather under one-ninth of a penny. That is an exceedingly economical result, which practically no steam engine with anything like the same dimensions can attain. Speaking now of the future, although many of these producers are working at the present time, yet the future development is likely to be enormous; the competition with coal gas will be very keen; and the competition with other kinds of power will also be very keen. Producers are now made in this country by the Dowson Company in series of from 10 to 200 horse-power, and, in a very short time, producers will be made of that type up to 2,000 or 3,000 horse-power. If necessary, Mr. Dowson tells me, he is in a position to build 500 horse-power suction producers if they are required.

A very large installation of these producers is now working at the Electric Lighting Station at Walthamstow. The installation consists of a number of generators, each capable of developing enough gas for 375 horse-power, and Mr. Dowson tells me that now he has instructions, and he is busy adding more producers, so as to bring up the total power of the station with producer gas for the electric light, to 3,600 horse-power, a very creditable result.

A very great point about the suction producer, in addition to its being a motive power much cheaper than can be got with coal gas, is the possibility of its application in many other ways, and for many other purposes; for example, for ships and motor cars. There is a large field open to the engineer who can successfully apply suction producers on board ship; many such attempts have been made, and I will refer to some a little later. I may say, of course, that Mr. Dowson is the oldest of the producer inventors and producer manufacturers, and I have given his name the preference; but nearly all engineering firms who build engines now, build producers as well, so that we can have suction producers for practically any purpose.

The sizes of the suction producers in operation at present in Britain vary from about 10 horse, as the lowest, up to about 200 horse, as the highest. There are pressure producers also using anthracite which go up even as high as 300 horse, not in one unit, of course, but in several units. Without doubt the suction producer offers very serious rivalry indeed to coal gas, and to compete with it on equal terms, the ordinary coal gas would require to be delivered to the consumer at about 9d. per 1,000

cubic feet. I think that is a matter which gas manufacturers should consider seriously, because a very large part of the present success of coal gas supply depends upon three things: the first is the incandescent gas light; the second is the gas stove; and the third is the gas engine; and the coal gas manufacturers will find that they have a very serious rival indeed in the suction producers. In only one town in England do I know of a case where gas is supplied at anything like the above price. Mr. Carr, the gas engineer of Warrington, sells his gas for power purposes, at 1s. per 1,000 cubic feet—a very admirable thing to do, and an example worthy to be followed by other gas manufacturers if they can.

Interesting developments, it seems to me, are very sure to follow the keen competition which has now set in between these two sources of power, coal gas and suction producer gas.

Many attempts have been made to utilise cheap bituminous fuel for producers, but so far the early commercial stage only has been reached. Commercial success here will come in the near future, owing to the great further reduction in the price of fuel for gas. In the present suction producers, the fuel used is anthracite, and anthracite in London, and wherever there is much carriage, comes to about 24s. a ton. If one could use ordinary engine slack, which can be got at most places at 10s. or 12s. a ton, or even less, one would have a corresponding reduction in the cost of motive power, and instead of coming out at a ninth of a penny, the cost might run down to as low as a twentieth of a penny.* Messrs. Crossley have recently produced a bituminous producer which seems to be working very fairly well. I have only seen one at work but it was working very well indeed. It is rather larger and has more plant about it than an anthracite producer, but still the fuel is so cheap that no doubt it is worth a great effort to get something of that kind. Other attempts have been made, and I wish to distinguish between the two classes of those attempts. There is not much difficulty in making producer gas for gas engines from bituminous fuel, if you are content to put up a large scrubbing plant such as is used with the Mond producers, and such as is used in a gas works; but people using steam boilers are accustomed to see a very large generation of power in a very small boiler space, and they do not look upon the large costly plants which are used in some places, although very useful, as solving this particular problem of getting a producer that will work just like a steam boiler with the ordinary fuel. So much for the suction and producer gas generally.

I must now consider shortly the question of blast furnace gas. Mr. Thwaite—I am glad to say an Englishman—demonstrated in 1895 that the so-called waste gas from blast furnaces could be used in gas engines. He built an engine and plant which was very successfully applied at a blast furnace in Britain, only on a relatively small scale. He showed quite clearly, however, that such gas from blast furnaces could be efficiently used for the purpose of motive power, and that it did not want a too expensive course of scrubbing. In England his work was not taken up with any enthusiasm—one does not quite know why, but some German and Belgian engineers took the problem up with great earnestness. The first to attack the problem of using blast furnace gas, after Mr. Thwaite, on a really large scale, was the Cockerill Company, at Seraing, in Belgium. They fitted up a 200 horse-power gas engine, designed by M. Delamare-Deboutteville, who unfortunately died some time ago—a very able engineer, who devoted himself to large gas engines. They further took gas from the blast furnaces of the works at Seraing, and they found that it would operate a 200 horse-power engine practically without scrubbing at all. The gas engineers in Britain, and, in fact, all those who had had experience in gas engine work, had always felt that the great difficulty in attempting to work blast furnace gas at all was the difficulty of scrubbing, because a very small amount of grit or tar coming in with the gas spoils an engine. The manager of the works, Mr. Greiner, a very able engineer, became so delighted with this success, and with the absence of scrubbing, that he wrote a very interesting paper, in which he announced that the scrubbing difficulty, and the dust difficulty, was a myth of the imagination of engineers; and he built a very large Cockerill engine, which was exhibited in Paris, and which was called a 1,000 horse power engine. He got that to work successfully. Then he took orders for a very large installation in another part of Germany, at Differdingen, and when he got his plant to work there, he found unfortunately that what was true of Seraing was not true of Differdingen. He found that both his pistons and his valves were in serious trouble in a very

* Scotch anthracite can be delivered at Glasgow at 15s. per ton, so that in Scotland power may be obtained at a cost of about 1-15th of a penny per horse-power hour.

short time because of dust. He found then that dust in gas depended very largely on the composition of the iron ore which was being smelted. In one district a gas was obtained which was practically free from dust; in another district the gas was laden with a fine silicious dust. There were two difficulties: one was the dust, and the other was the tar. For a long time very considerable effort was made on the Continent to get over these difficulties, partly by scrubbing with ordinary scrubbers, such as are used in ordinary gas works, and partly by using a centrifugal separator, whirling round the gas with a great velocity, and a spray of water, they were able to separate out both tar and dust, and that difficulty may be said now to have been removed. Another difficulty was the cooling of the gas: as the gas leaves the blast furnace it is very hot, and to cool that great volume of gas, many cubic feet an hour, would be a difficult matter with water, so that air cooling is mostly used.

As the result of this work, there are now on the Continent quite a number of installations of engines using blast furnace gas. At Hoerde there are two distinct systems in operation—the Deutz and the Oechelhauser. The Koerting and Cockerill engines are also largely used.

For a time English manufacturing engineers fought rather shy of these engines, because the risk seemed too great; but now the subject has been thoroughly taken up, and the engines are being established at a very considerable rate in this country. There are three places where they are at work: One is at Messrs. Cochrane's Works at Middlesborough, where they have two Cockerill engines, one 500 horse tandem double acting, which works very well indeed, and another large engine of 600 horse-power, with a single cylinder. Then at Sir Alfred Hickman's, at Wolverhampton, they have several systems at work, including Cockerill, Crossley, and Premier.

Messrs. Mather and Platt, of Manchester, too, have taken up the subject, and they have built engines for blast furnace and producer gas—the Koerting 700 horse for blast furnace gas, particularly.

Messrs. Beardmore, in Glasgow, have now running a large Oechelhauser engine driving a rolling mill, and they have arranged a gas plant using bituminous fuel and scrubbing very extensively in order to make the gas fit for use in the gas engine. Altogether there is a very considerable movement at present, and I have no doubt in the very near future we shall have very many of these large engines working and utilising some part at least of this waste 1,000,000 horse-power of gas.

I do not, however, think that English engineers have been too slow. In England I consider that we have done our full share, both in the theory and practice of the gas engine, although on the Continent, no doubt, they feel the want of the large gas engine more than we do on account of the greater cost of fuel. Now that the attention of English ironmasters has been called to it, they will undoubtedly find the large gas engine help them in the struggle against other nations.

I now come to another important matter, and that is the question of the distribution of gas from a central station. The production of power gas for distribution from a central station has long been a favourite scheme of many engineers. Many years ago the late Sir William Siemens was very much in favour of such a scheme, and he for a long time advocated the establishment of central power gas stations and the distribution of gas for power from central stations—not gas for lighting. A very great and important experimental installation is just on the point of being completed for the South Staffordshire Mond Gas Company. I am informed by the engineer of the station that this great establishment will set to work in about a month, and will distribute cheap fuel gas over an area of something like 120 square miles. The maximum supply with the present plant, although there is room for extension, is something like 15,000 horse-power.

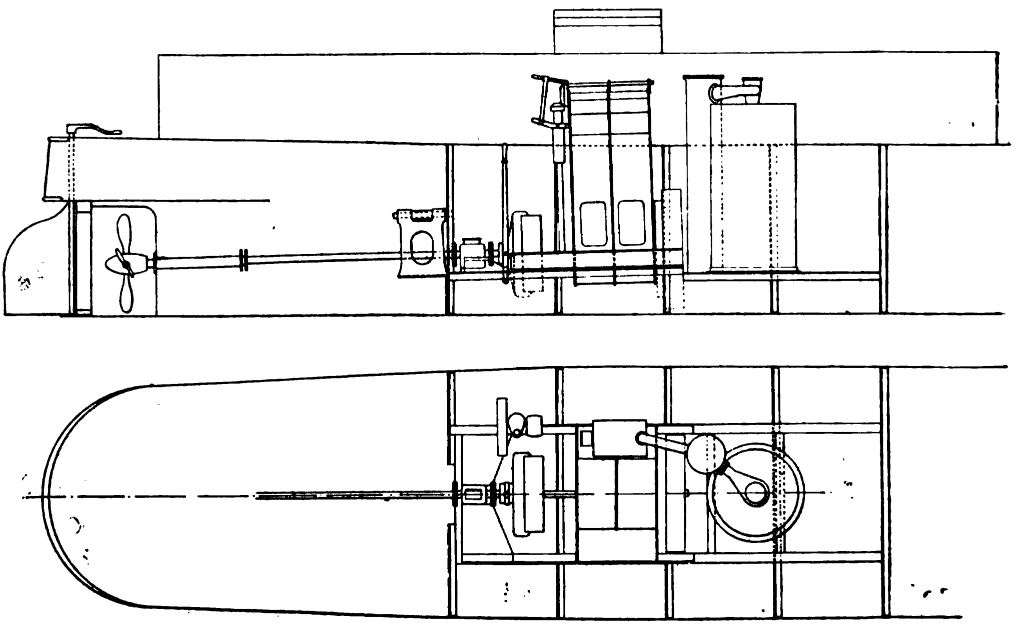
The Mond gas differs from ordinary producer gas in this: in addition to making the gas, the ammonia that is in the coal is saved. Many coals contain a proportion of nitrogen, and if these coals on being decomposed are not heated too highly, ammonia is formed and is not decomposed. To keep the temperature of the producer down sufficiently, the Mond practice is to flush the producer through with a very large volume of steam in addition to the air—much more steam than is wanted for the chemical decomposition. About 2½ tons of steam are used for every ton of fuel. The inflow of steam into the producer has two purposes; the one is that it keeps down the temperature and prevents the ammonia being lost; the other is that it prevents the formation of clinker, and the stopping up of the producer. In this arrangement to get the ammonia out, it is necessary after scrubbing and getting the

tar out of the gas to scrub the gas in great acid towers, making quite a gas works installation. This does not belong to the type with which I consider the producer should be concerned, that is, the type of producer which takes the place of a steam boiler, and does its work with no more complication than the boiler.

To distribute the Mond gas, it is necessary to put it under some pressure, because the volume required is so very great. The calorific value is only about one-fourth or one-fifth that of ordinary coal gas. The consequence is that to distribute this gas over large areas it is necessary to put it under very much heavier pressure than is used with coal gas. The installation is therefore provided with a compressing house, intended to compress the gas for delivery in the mains. Mr. Humphrey tells me that a test was made recently at this establishment in which air was delivered along a main five miles long from these compressors at the rate of one and a-half cubic feet per hour. If that were pumping gas, this rate would be fully equal to about 15,000 horse per hour. This rate of delivery was attained with a pressure of 10 lbs. per square inch at the central station, so that it is thought that ample pumping plant and ample pipe accommodation have been provided to take the enormous volumes of gas necessary in this system. It will be very interesting indeed when this installation starts. It is one of the largest and most important experiments in progress in the world, and all engineers look with interest upon it, and wish it every possible success.

In carrying on the operations of this great station, it is required to pump water and acid to absorb the ammonia and to keep up the general circulation in the system. A large pumping house is, therefore, provided in addition to the other large erections, the whole forming a very important station.

FIG. 32.



CANAL BARGE *Duchess*, FITTED WITH PRODUCERS. BUILT BY MESSRS. THORNYCROFT.
Length, 71 feet. Beam, 7 feet. Draft, 3 feet 9 inches. Speed, 6 miles per hour. B.H.P., 30.

The same trouble which is met with in blast furnace gas is also met with in gas of the type of Mond gas, the tar being the great difficulty. If there were no tar to deal with, all these matters would be very simple, but in a large installation, such as this South Staffordshire Company's installation, there is no real difficulty, because there is space enough to build up the scrubbers; but if anything of that sort had to be done on board ship, say, it would be a very different matter.

Another development which is taking place —and it may be said to belong really to the future—is the application of internal combustion motors to boats or ships of different

kinds. The first application—and, of course, the easiest one—has been the application of petrol engines for the purpose of motor boats. An example of this application is found in the Napier motor launch—a very interesting machine. This launch has a single shaft propeller—a four-cylinder engine with all the same kind of gear and parts for operating and reversing that is used in the motor car. In fact, so far as these motor boats are concerned, they may be practically considered to be boats in which motor-car engines have been fitted with all the usual gear—that is, the usual clutch and reversing gear. There is no attempt to reverse directly by the engine.

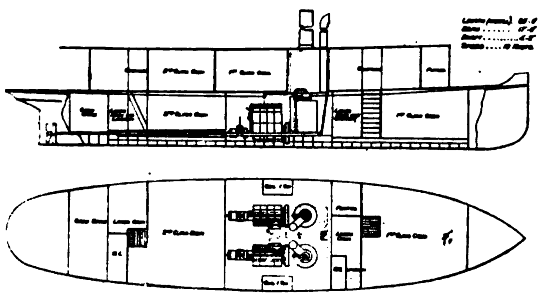
I now come to the second and much more important application, viz., the application of producer gas, the suction producer, or any other producer, to sea-going purposes. The sources of petrol are so limited that one cannot expect to do anything great in the way of motive power at sea with petrol. There is not enough petrol, and there is not enough oil, in the world. Any sort of run upon petrol by a huge use of petrol engines would at once put up the price, because the amount of petrol in the world is so small. In fact the amount of the oil is so small, that if it were attempted to run anything like the tonnage of this country with petrol or with oil, it would be impossible to get enough petrol and oil in the world to do that. The consequence is that the real marine problem can only be solved when coal in some form is used on board ship. M. Capitaine, of Frankfort, has built a producer gas tug at Frankfort-on-the-Maine, and Messrs. Thornycroft, in this country, have taken up the Capitaine designs. Fig. 32 shows the first boat built in England, a canal barge, *The Duchess*, which is to have a motor of 30 horse-power on board. This boat is now being built, and is expected to be going very shortly; great economy is expected, 30 horse-power being obtained at a cost of about 3d. an hour, *i.e.*, one-tenth of a penny per horse-power per hour for fuel, comparing most favourably with steam.

Fig. 33 shows a passenger boat which Messrs. Thornycroft are now building with suction producers. In this case, double cylinder engines and two producers are used. It is noticeable into what a small compass the cooling and scrubbing plant are arranged. By using good anthracite and a very fine water spray, M. Capitaine succeeded in reducing the compass of his scrubbing plant to very small limits indeed.

These experiments are extremely important, and I have no doubt at all that in a few years huge liners will be run without steam at all, with nothing but gas plant and gas engines on board, using electricity for their auxiliary power.

Now with reference to the line of advance in future. There are many things still open for ambitious young engineers to do in this line of work, both in the improvement of the engines themselves, in the production and supply of fuel, and in the application of these engines to many other purposes. First, then, with reference to the thermal efficiency—the thermal efficiency of these engines has improved enormously. In 1882 the indicated efficiency, that is, the amount of heat converted into work

FIG. 33.

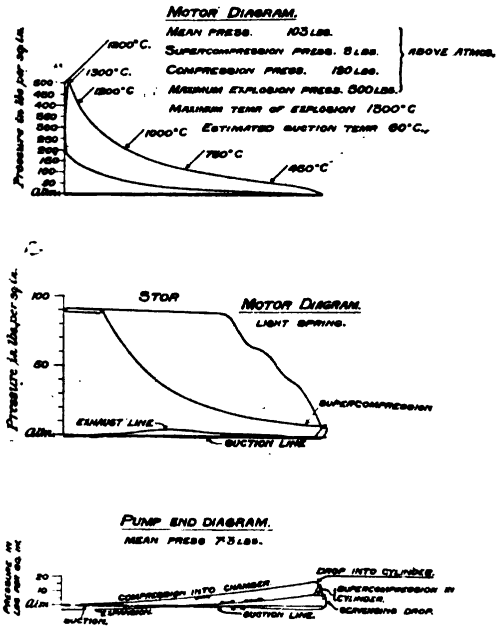


PASSENGER BOAT, BUILT AND FINISHED WITH SUCTION PRODUCERS BY MESSRS. THORNYCROFT.

in an ordinary first-class gas engine, was 16 per cent.; in 1900 it had risen to 31 per cent.; and, at present, that is, since 1900, in the last four years, the efficiency of a large first-class gas engine may be taken at as high as 35 per cent.; that is, in some cases more than one-third of all the heat given to the engine is converted into indicated work. That change has taken place since 1882, and it is natural that one should ask one's self, "Can these engines be much further improved?" I have no doubt they can. A little consideration of the different cycles will show that if the constant pressure cycle could be adopted, and the difficulties of the constant pressure engines overcome, we should be able to get an engine the same weight as the present constant volume engine, giving instead of a theoretical efficiency of about 48, a theoretical efficiency of about 63 or 64; and we should get a practical indicated efficiency of considerably over 40 per cent. That is one way of increasing the efficiency. There are other ways. One is

to reduce the temperature of the flame. That can be done without losing economy, because, as I pointed out in my first lecture, the efficiency, that is, the economy of any Otto four-cycle engine, is independent of the maximum temperature of the flame, if the temperature of the flame is above the temperature of compression. The consequence is that if we can keep up the average pressures, we may reduce the temperatures if we like.

FIG. 34.



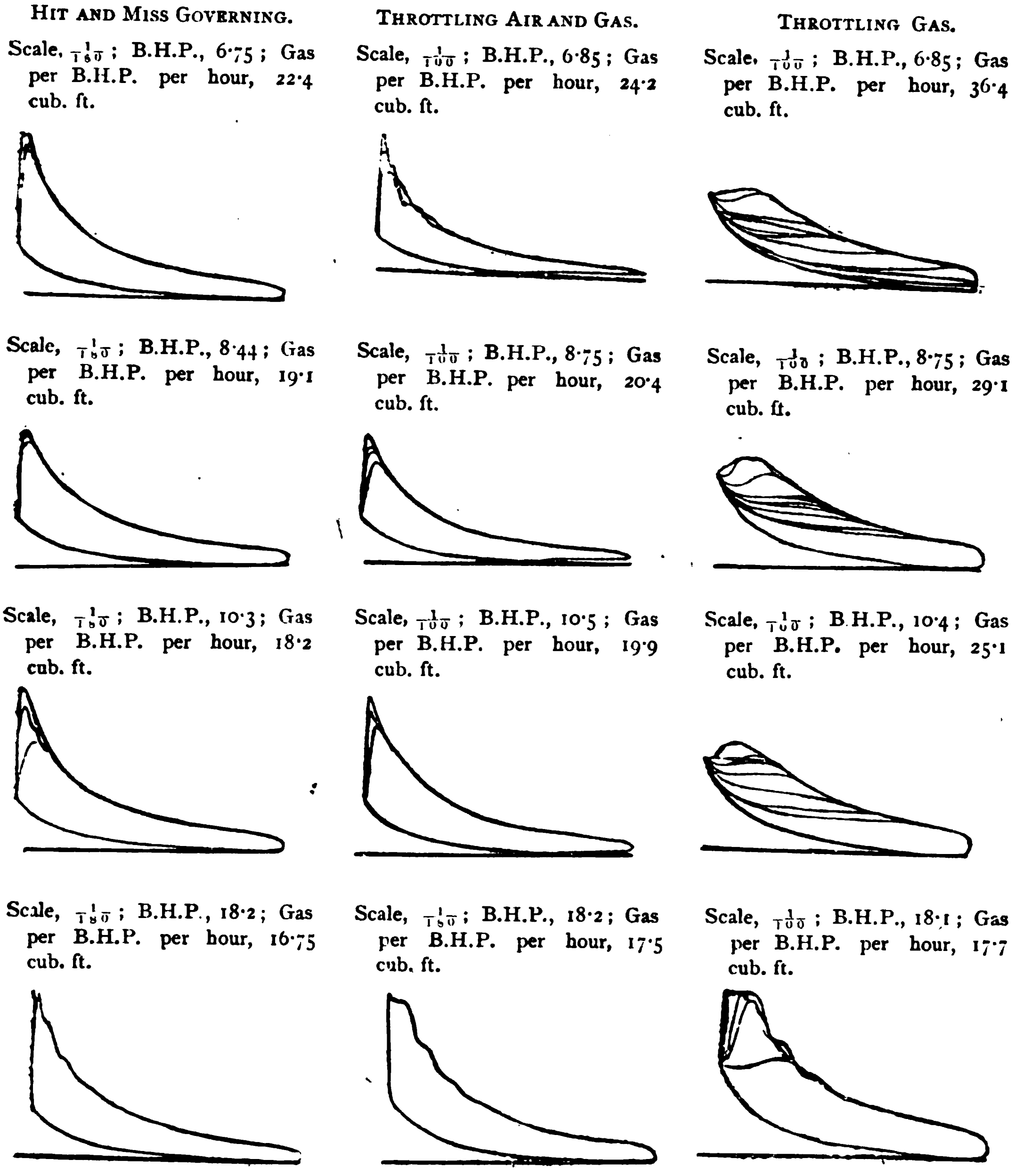
DIAGRAMS FROM NATIONAL AIR SUPERCOMPRESSION ENGINE.

With regard to the large engines, particularly, it is desirable to reduce flame temperatures to the lowest possible point at which complete combustion can be attained, at the same time increasing the charge weight in order to maintain mean pressure. In this way the cylinder and pistons are enabled to withstand the strains of unequal expansion, and troubles from irregular ignition of various kinds are avoided. I have been working on these lines with fair success. Fig. 21 shows a 300 horse-power engine at work in St. Helens on the air supercompression principle, designed by myself in conjunction with my colleagues at the National Gas Engine Company. In this engine a considerable quantity of air under pressure is introduced into the cylinder at the end of the charging stroke, the air having been compressed in front of the piston; this raises the pressure before the usual compression commences to about 7 lbs. above atmosphere. The compression stroke then proceeds, and explosion and expansion take place in the usual manner. Fig. 34 shows diagrams taken from this engine, and it will be seen from these diagrams that the temperature of combustion is reduced to about 1,200 C. as compared with the 1,600 C. or 1,700 C. usually reached, while the pressure is kept up, the mean pressure being as high as 103 lbs. per square inch. This engine works very well indeed; but it involves some little extra expense in the air-pump arrangements. In order to reduce the cost, I have designed a method of exhaust supercompression. In this method the exhaust gases from the engine are trapped under pressure and cooled, and then introduced at the end of the charging stroke instead of air, as above described. This method is now working on an engine of 10 inches by 18 inches, and we intend to build a large engine utilising the principle. The object aimed at in both these engines is to diminish the temperatures, and so diminish heat loss and avoid pre-ignitions.

Many attempts have been made to compound gas engines, but none have, as yet, succeeded. The more important points for immediate attention in connection with the development of the gas engine, or internal combustion motor, are not on the thermo-dynamic side; the more important points are on the mechanical side—that is, to improve the number of impulses, to improve the mean torque so that it may be more regular, and to produce methods of governing that are quite regular and quite reliable. Fig. 35 shows the results of a set of experiments made by my colleague, Mr. Bradley, of the National Gas Engine Company, on a 9-inch by 17-inch engine, illustrating the three different modes of governing in use all over the world at present in these engines. The diagrams in the first column show the effect of the ordinary hit-and-miss type, which is so much used in Britain and is the most economical of all. The second column shows the effect of throttling air and gas, and the third column the effect of throttling gas alone. A series of diagrams of brake tests were made at different loads. With the hit-and-miss governor, at a brake horse-power of 18·2, the gas consumption is 16·75 cubic feet per B.H.P. At a brake horse-power of 10·3, the consumption has gone up to 18·2; at brake horse-power 8·44 the consumption is 19·1. With a third of

the power the consumption has gone up to 22·4 cubic feet per brake horse-power. That is a very good result, even at the light load. The second column of diagrams show the proportion kept unaltered. Here we find that at 18·2 B.H.P., the consumption has gone up a little to 17·5 cubic feet per brake horse-power; at 10·5 B.H.P. it has gone up to

FIG. 35.



COMPARATIVE DIAGRAMS SHOWING RESULTS PRODUCED BY VARIOUS METHODS OF GOVERNING.
National Gas Engine; Type "R"; 9″ Diameter; 17″ Stroke; 200 Revs.

the same engine governing on the throttle, as is the practice on petrol engines, that is, the gas and air are choked by the governor together, so that gas and air shall be equally choked, and the total supply diminished; but 19·9; with 8·75 B.H.P. it is 20·4; and with 6·85 B.H.P. it is 24·2. There you find a very fair governing indeed at a third of the load. On the third system, not throttling the mixture, but throttling the gas only, so that the

proportions of gas and air are changed, we get at a brake horse-power of 18·1 a consumption of 17·7, which is about the same as on the second system, where the mixture is throttled. Then with brake horse-power 10·4 we have 25·1; with brake horse-power 8·75 we get 29·1; and with 6·85 brake horse-power, we get a consumption of 36·4 cubic feet per B.H.P. hour, so that this method of governing involves an enormous disadvantage. This is, however, one of the methods that is sometimes used in large engines. The best known method of governing for giving uniformity of impulse and fair economy at the same time, is undoubtedly throttling the mixture, and that is the method which is used in most large gas engines. These matters are open for the future. In marine work, too, it is necessary to be able to reverse the engine itself. In all the marine gas engines or marine petrol engines which have been used yet, the engine is not reversed; the clutch is thrown out, and the gear is altered. That does very well for a moderate power engine, but it would not do for a big 5,000 horse-power engine. The problem of reversing the engine and dispensing with the reversing clutch gear is one that still awaits solution.

I will only say one word about the gas turbine, and that is this: until someone invents or discovers an efficient gas and air compressor of the turbine type, there is no possible hope for efficiency with the gas turbine. The problem is very much more difficult than the problem of internal combustion in the cylinder. It must not be assumed that the same things which hold good in the steam turbine hold good in the gas turbine.

In the direction of improved fuel, lighter producers have to be invented and will be invented. They have to be made easily capable of using any fuel, bituminous and non-bituminous, and that will all come. Special engines have been designed for motor cars and heavy goods carriages with gas producers, and I have no doubt that a suction gas producer, with, say, wood charcoal fuel, could be made for a motor car. It would not be quite so light as the present motors, but very nearly so, and it would be very much more economical and safe. At first, however, the combination of suction producer and gas engine will be applied on very heavy vehicles and canal boats.

In concluding, I would like to read to you two paragraphs from a paper read by me before the Institution of Civil Engineers exactly twenty-three years ago—in 1882:—

"The gas engine is as yet in its infancy, and many long years of work are necessary before it can rank with the steam engine in capacity for all manner of uses; but it can and will be made as manageable as the steam engine in by no means a remote future. The time will come when factories, railways, and ships will be driven by gas engines as efficient as any steam engine, and much more safe and economical of fuel. Gas generators will replace steam boilers, and power will not be stored up in enormous reservoirs, but generated from coal direct as required by the engine."

Well, I was in those days much younger and more enthusiastic, and perhaps more venturesome, and more liable to prophecy things; but I think I may claim that that prophecy, made twenty-three years ago, if not absolutely true, is rapidly becoming true. All that I would like to say now is, that twenty-three years ago the gas engine was in its infancy, but now it is in its early manhood, with a very long career of usefulness before it.

MEXICO.

The economic progress of Mexico during the last quarter of a century has been very remarkable, and the Government of Mexico has acted wisely in directing special attention to this development. The statistics that prove it are to be found in Blue-books, but Blue-books have not a large circulation, whereas a small pamphlet will be read by many. Such a pamphlet, called "Mexico: Yesterday and To-day, 1876-1904," has just been published under the auspices of the Mexican Government, and is referred to by Mr. Consul Jerome in his report on the trade and commerce of Mexico just issued (No. 3429, Annual Series). It may be interesting and useful to note some of its figures.

Take first telegraphic communication. The following tables indicate the growth:—

		1876.	1903.
Federal Government telegraph lines ..	(miles)	4,434	31,270
State do.	,,	814	3,239
Private do.	,,	749	1,934
Federal Government telephone lines ..	,,	—	208
State do.	,,	—	10,030
Private do.	,,	6	13,125
Receipts from the telegraph service.	(dols.)	93,302	2,119,281
Offices, including two with wireless telegraphy installations..........		109	418

One of the principal causes of the progress, commercial and social, of Mexico has been the development of the railways. In Northern Mexico construction was comparatively easy, but in the central table-

lands high mountain ranges had to be traversed, while in the south and on the coast the climate rendered construction work very arduous. Nevertheless, development has been very remarkable, as the following figures show :—

	1876.		1903.
Railroads in operation	6	..	87
Miles constructed	567	..	16,285†
Passengers carried....	4,281,327	..	50,343,744
Merchandise (tons) ..	133,000	..	6,668,499
Electric tramways (miles)	—	..	265
Animal traction tramways (miles)	470	..	2,855
Passengers carried on tramways..........	*	..	38,452,675
Transported on tramways (tons)........	*	..	25,973
Federal subsidies to railways (dols.)	5,151,905	..	144,891,743

The revenue of the Federal Government in 1876 amounted to $19,088,158, in 1903 it was $81,061,078.

The increase in the shipping carrying on the international trade of Mexico, as shown in the following table, is of exceptional interest, the minor carriers being left out :—

Flag.	1885-86. Steam. Number of Vessels.	Steam. Tons.	Sailing. Number of Vessels.	Sailing. Tons.
British	132	155,930	31	10,110
United States	522	716,799	174	37 511
Norwegian	3	1,149	82	27,058
Spanish...	79	125,189	67	6,509
German...	36	46,736	87	29,982
French	14	22,631	20	6,317
	1902-03.			
British	305	808,303	138	31,971
United States	238	694,572	210	6,412
Norwegian	201	293,928	55	25,201
Spanish...	64	248,231	5	977
German	85	272,008	23	32,942
French	14	80,234	...	...

It will be noticed that whilst the Americans carried less in 1902-3 than in 1885-6, British steam tonnage increased more than five-fold, and whereas in 1885-6 it was little more than a fifth of the American, in 1902-3 it exceeded it. The comparative increase in German tonnage has been even greater than in British.

One of the most interesting features of modern Mexico is the development of education. In various parts of the republic, even in the most unexpected places schools similar to the Board schools of England exist. The statistics given by the writer of the pamphlet referred to above, Mr. Madden, are noteworthy.

* No data. † 16,387 miles in 1904.

GOVERNMENT SCHOOLS (FEDERAL, STATE, AND MUNICIPAL).

	Number. 1876.		1903.
Primary schools....	4,542	..	9,546
Pupils— Males	101,748	..	383,381
Females	48,981	..	248,134
Secondary and high schools	173	..	351
Pupils— Males	10,654	..	25,051
Females	3,316	..	16,446
Total school teachers and professors— Males..........	3,200	..	8,063
Females........	1,228	..	6,393
	Dollars.		Dollars.
Expenditure	2,049,045	..	9,060,325

The private schools (Catholic, Protestant, and Secular) also show considerable increase. 764,353 children of both sexes attend the 11,590 schools at present existing in the republic. It is interesting to note the number of women who in the last five years have entered into competition with men as clerks, typists, shorthand writers, in the post and telegraph offices, and as shop assistants. There are to-day 124 public libraries, 39 scientific associations, and 37 museums of all kinds in Mexico, and while electricity was unknown in Mexico in 1876 now there are some 100 towns lighted by electricity and 250 plants for power and industrial purposes in various parts of the Republic.

Turning to British trade with Mexico, and having regard to the great development of the country and consequent increase in its requirements, it cannot be said that the following figures are very satisfactory :—

	Value. 1874-75 (Fiscal Year).		1903-04 (Fiscal Year).
Imports into Mexico from United Kingdom	£1,731,433	..	£2,003,230
Exports from Mexico to United Kingdom	£1,843,967	..	£2,499,146

Going more into detail the following figures show the value of imports into Mexico from principal countries during the years 1899-1904 :—

Years.	United States.	United Kingdom.	Germany.	France.
	£	£	£	£
1898-1900.......	6,205,283	2,096,640	1,334,769	1,351,428
1900-01	7,037,991	1,984,910	1,415,990	1,312,847
1901-02	7,806,438	1,652,826	1,290,441	1,257,172
1902-03	8,102,909	2,123,069	1,914,802	1,307,885
1903-04	8,521,754	2,003,230	1,908,216	1,494,415
July 1 to Dec. 31, 1904	4,555,533	998,596	1,054,365	814,728

It will be seen that in the last half of 1904 Germany takes the second place, while the United Kingdom drops to the third, and the preliminary statistics for the first months of the present year show that the Germans maintain their place. The increase in imports from Germany are due, in great measure, to increased facilities owing to the improved direct steamship service between the two countries, the agents from the German lines doing all they possibly can to obtain freight. Mr. Consul Jerome is inclined to attribute the falling off in British imports to the lull in 1904-5 in railway construction, and consequent diminution in the imports of railway material, added to the successful competition in this trade by the American Steel Trust, and the fact that the rails are now also being manufactured in Monterrey.

Mr. Consul Jerome refers with reluctance to British trade methods, which, in his opinion, militate against the increase of British trade with Mexico, and give commercial rivals avoidable advantage. He refers more particularly to the formalities required in the shipment of goods and to Mexican customs that ought to be observed. Probably in no country in the world is competition keener than in Mexico, and where mistakes are made and continually repeated in spite of protests of both the consignees and resident representatives of British firms, advantage is immediately taken by competitors. Many of these mistakes are apparently made, says Mr. Jerome, "by permitting the export business of a house to be conducted by a junior clerk, and the partners not giving matters of detail the amount of consideration which would prevent any repetition when once mistakes have been brought to notice." Mexican Customs regulations require that besides the previous Consular invoice, a signed copy or stamped bills of lading covering goods imported into the Republic of Mexico must be presented at the Custom houses. As this copy is retained by the Custom authorities it follows that the consignee must also have a stamped and signed copy too for him to obtain the delivery of the goods from the carriers. "British firms are particularly refractory as to these regulations. The result has been a good deal of annoyance, and a considerable drop in the volume and value of British imports. I know," continued Mr. Jerome, "of one firm who have instructions to the above effect printed, which they send with every order to their correspondents in the United Kingdom, and yet in nine cases out of ten the request is not complied with." Mr. Consul Jerome proceeds to give many useful hints to shippers who may be recommended to study the whole of his present very valuable report. Among other things he warns the British public against the allurements of promoters who may have rubber "propositions" to dispose of. He says that the numerous plantations for the cultivation of rubber have hitherto not proved successful undertakings; that is, as dividend earners; and much harm has been done to the genuine ventures of this kind by the operations of a number of fraudulent concerns having their head quarters in the United States. Foiled in their own country, the promoters of these schemes are now turning their attention to both the United Kingdom and Canada. It may be noted that bananas, cultivated in Mexico hitherto only for home consumption, are now beginning to be grown for export. Having regard to the shortness of the haul to points in the United States the Mexican grower should have it all his own way, and the Mexican banana, and other tropical produce, is likely soon to compete very seriously with those from Jamaica and other West Indian Islands.

THE COSTA RICAN BANANA INDUSTRY.

The banana industry, unknown to Costa Rica twenty-five years ago, has reached such proportions, especially within the last few years, that bananas now form the main export of the country. It is no longer an industry in its infancy, but an industry as important as that of coffee, which for a long time has been the mainstay of the Republic. At the close of 1904, about 50,000 acres were devoted to banana growing in Costa Rica, of which 90 per cent. are owned by the United Fruit Company, a corporation organised under the laws of New Jersey, and controlling probably 75 per cent. of the total production. At present the market for this fruit is highly encouraging, and bids fair to continue so for many years to come. The United States representative at Port Limon says that the trade was exclusively confined to the United States until 1902, when it was introduced in England, with gratifying results to the exporters. France, Germany, Italy, Spain, and other European countries, do not as yet consume the banana, but as soon as a substantial increase in the acreage is reached, and with the present facilities for transportation and the use of ships equipped with cold storage, the market should, and no doubt will, be extended to those countries, with results equally gratifying as in England. There appears to be very little fear of the demand for bananas ever ceasing to exist. Bananas are not luxuries alone, but nutritious food, and being cheap, will always be used by all classes and for many purposes. The amount exported from Port Limon during the five fiscal years ended with June 30, 1904, was as follows, in bunches:—1900, 2,804,103; 1901, 3,192,104; 1902, 4,427,024; 1903, 5,261,600; and 1904, 5,760,000. During the six months ended December 31, 1904, the exports amounted to 2,911,071 bunches. As shown, banana exports have more than doubled during the last five years, and present indications are that the exports will double again during the next five years. As an investment, the United States representative says: "Taking into consideration the quick returns and the readiness and ever-increasing sphere of market, I consider banana cultivation quite profitable. On a conservative estimate 40 per cent.

per annum can be realised to investors, under good management and normal conditions." The following figures show the probable cost and profit on a tract of 100 acres planted in bananas. Original outlay—land (£4 per acre), £400; reducing land and bringing it to a banana-bearing condition (£10 per acre), £1,000; total, £1,400. Gross returns, 180 stems per acre per annum, £1,116. Expenses—cutting and hauling the fruit, and keeping the plantation clean, £288, manager (£20 per month), £240; total, £528. Net return on investment, £588. The entire banana crop at present is sold to the United Fruit Company, which works a railway system through the fruit districts, and pays about sixteen pence per stem on delivery alongside their track. Under very favourable circumstances, a banana plant may give a stem of fruit in nine months, but it generally takes from fifteen to eighteen months for the average plantation to be in full bearing. The life of a plantation varies according to the fertility of its soil and topographical situation. Some soils may need a rest in six or seven years, while others may last practically for ever, as in cases where periodically enriched by alluvial deposits. Plantations fifteen years old yield at the present time as many bananas as they did in their second or third year. Sandy loam, through which water or rain will freely percolate, is the best soil for bananas. The stalk needs a large amount of rainfall for its successful development, but water must not be allowed to remain on the surface or immediately under the surface of the soil surrounding it, lest the water be heated by the tropical sun and become stagnant, in which case it may kill the plant. Jamaican negroes are exclusively employed as labourers, and their average pay is about 3s. a day. The negro is immune from yellow fever, is indispensable, and the only person really adapted to the work required in districts where, by reason of the richness and more or less swampy nature of the land, mosquitoes abound, and the dangers of contracting disease are comparatively great. The implements used in cultivating bananas are steel machetes, axes, shovels, and ploughs. Many plantations are equipped with narrow-gauge railways and horse cars for hauling fruit. The rails used are very small. Machetes, axes, and ploughs are generally imported from the United States. Shovels come from the United Kingdom. Rails are imported from the United States and Germany, but chiefly from the latter country on account of the difference in prices. It is understood that fine flour can be made from bananas, and that fibres from the leaves and stalks could be extracted and successfully worked, but as yet nothing in this direction has been done in Costa Rica.

SALT MINING.

An interesting paper on Salt Mining and Salt Manufacture in Cheshire, has lately been read by Mr. John Hall, before the Manchester University Union, from which the following particulars are taken:—

The town of Northwich is one of the Cheshire Wiches or Salt towns. It is situated almost in the middle of the county of Cheshire, on the River Weaver, which is capable of allowing vessels of two hundred tons burden and upwards to navigate its waters. This river empties into the River Mersey, near the small town of Frodsham. Runcorn and Liverpool, near to this place, are the shipping ports. Salt, or chloride of sodium, was made from a natural spring at Northwich in the earliest times certainly by the Romans and Saxons. A small salt pan made of lead, three feet long by two feet wide and four inches deep, was dug from the earth a few years ago; it is supposed to be Roman, and is now in the Museum at Northwich. In the Domesday Book, Northwich is mentioned as Wich. It was at Northwich that rock salt was first discovered in England, in the year 1670.

Prior to this date, the manufacture of white salt, chloride of sodium, Na.Cl., from brine, had been very small.

In the year 1679, the quantity made at Northwich was estimated to be about 15,000 tons in the year. During the present century, the quantity of salt manufactured has increased very much, and now half a million tons of white salt and over 60,000 tons of rock salt are sent away every year from the Northwich district. The beds of rock salt underlying the town and neighbourhood of Northwich have been proved to extend over an area of four square miles. It is probable that they are even more extensive. These beds occupy the lowest portion of an old salt lake of Triassic times, which covered a very much larger area than that of the existing beds of salt, as is shown by the Keuper marls which were deposited in it. There are two main beds of salt, or one bed divided by marl. The salt is overlain by the saliferous Keuper marls, and these by the boulder clays, sands and gravels. The first bed of salt is met with at a depth of about 40 yards, varying according as the surface varies. Its thickness averages about 25 yards. Below this bed there is a stratum of much-indurated Keuper marl, about ten yards in thickness, and this is succeeded by the second or "bottom" rock salt. This second bed of rock salt is about 35 yards thick. It is in this lower bed of rock salt, which was not discovered until 1781, that all the existing rock salt mines are worked. The earliest mines were worked in the first bed of rock salt, afterwards, when the second bed was discovered, the first bed was abandoned.

The brine from which the white salt is manufactured exists naturally only on the surface of the first bed of rock salt. The water from the rainfall, making its way to the rock salt, dissolves the salt and becomes brine. Salt is very soluble, and water, when fully saturated with it, contains nearly 27 per cent. Some of the mines in the second stratum having been worked out, have filled with brine, and

are large reservoirs out of which a large portion of the brine for the mauufacture of white salt in the Northwich district is pumped. There are two distinct methods of obtaining the salt from the salt beds. The first is by ordinary mining, when the natural or rock salt is obtained. The second is by pumping the brine, and then obtaining the salt by evaporation of the water in iron pans.

In preparing common salt, the brine is first raised to a boiling heat, with a double view of bringing it as quickly as possible to the point of saturation and of clearing it from its earthy contents. The fires are then slackened, and the evaporation is carried on for twenty-four hours with the brine heated to 160° or 170° Fahrenheit. The salt thus formed is in quadrangular pyramids, or hoppers, which are close and hard in their texture. The remainder of the process is similar to that of making stoved salt.

Large grained or fishery salt is made with an evaporation conducted at the heat of 100° or 110° Fahrenheit. No perceptible agitation, therefore, is produced in the brine, and the slowness of the process, which lasts from seven or eight to ten days, allows the chloride of sodium to form in large and nearly cubical crystals, seldom, however, quite perfect in their shape. For ordinary domestic uses stoved salt is perfectly sufficient. Common salt is adapted to the striking and salting of provisions which are not intended for sea voyages or warm climates. For the latter purpose the large grained or fishery salt is peculiarly fitted.

For this latter purpose, and for the salting of fish a few years ago, large quantities of bay salt were imported to this country from abroad, and was much esteemed until an exhaustive chemical analysis proved that it was inferior to the English-made large-grained fishery salt. After this the English make was more in favour for salting fish, &c., and now enjoys a very large consumption.

AUSTRALIAN INDUSTRIAL THRIFT.*

A leading financial authority lately declared that the savings bank constitutes the true criterion of the well-being of an industrial community. Judged by this standard, the condition of the industrial classes in the Commonwealth is superior to that of their brethren in Great Britain, the average amount of savings bank deposits in Australia being £31 17s. 2d. per head, against £18 4s. 10d. in the Mother Country. And this is exclusive of industrial investments in land and building associations and other financial institutions. In one respect the Australian savings banks differ from most of those in Great Britain, being more or less under State control, and thus efficiently safeguarded. They are of two classes, those worked by the State in conjunction with the Federal Post Office, and those managed by commissioners or trustees, who are generally nominated by the State Government. In New South Wales the Trustee Savings Bank was established in 1832, and the Government Savings Bank in 1871. In both institutions sums of one shilling and upwards may be deposited, but interest is not given on any individual amount in excess of £300 save in the case of friendly societies and charitable institutions. In Victoria, the Commissioners' Savings Bank and the Government Savings Bank have been amalgamated, the new institution being empowered to make advances to farmers and others, in addition to the customary modes of investment. In Queensland, a Government Savings Bank not working in conjunction with the Federal Post Office, and dating from 1865, is in operation. In December, 1895, authority was obtained for the issue of Savings Bank Stock 3 per cent., to enable depositors of upwards of £200, the limit of interest-bearing deposits, to obtain interest on any excess, as it was found that large sums were entrusted to the State Government which could not earn interest under the old constitution of the bank. In South Australia, the existing Savings Bank, established in 1848, like the bank of New South Wales, is administered by trustees, the maximum amount of interest-bearing deposits being £250. In Western Australia, the Government Savings Bank, dating from 1864, accepts interest-bearing deposits up to £300, but the total amount must not exceed £600, nor may more than £150 be deposited in any one year. In Tasmania, there are both Government and Trustee Savings Banks, interest not being allowed on sums over £150. In 1903-4, the number of Savings Bank depositors in Australia was as follows:—New South Wales, 331,956; Victoria, 432,867; Queensland, 80,059; South Australia, 123,455; Western Australia, 56,628; and Tasmania, 47,904; making a total of 1,072,869, or nearly one-third of the white population, according to the census of 1901, showing the Australian industrial classes to be one of the most thrifty peoples in the world. The amount of deposits in each State during 1903-4 was:—New South Wales, £12,344 623; Victoria, £10,582,808; Queensland, £3,741,967; South Australia, £4,202,637; Western Australia, £2,058,619; Tasmania, £1,249,401; making an average total of £31 17s. 2d. per depositor, an amount exceeded only in America, Canada, and Austria-Hungary. The average amount per depositor is largest in Queensland, being £46 14s. 9d., and lowest in Victoria. The element of thrift is most largely developed in the country, where they assist largely in enabling settlers to provide against unforeseen contingencies. The system of book-keeping generally adopted is so efficient that any defalcation has become almost impossible, a fact which explains the confidence of the Australian people in these institutions. Previous to the establishment of the Commonwealth, most of the Government Savings Banks were largely under the control of the postal authorities, but with the transfer

* Communicated by Mr. John Plummer, of Sydney.

of the State Post Office systems to the Federal Government they have reverted to State control, with certain facilities afforded by the Federal Post Office.

GERMAN AND FRENCH ENTERPRISE IN CHINA.

As many German merchants are found to-day in the great cities of the interior of China as in the treaty ports on the sea coast. In Shanghai there are 68 German merchant houses which are doing 22 per cent. of the import trade of the city. In Tientsin there are 29 German houses, which control 45 per cent. of the exports and 60 per cent. of the imports. Fifty per cent of the imports and 75 per cent. of the exports of Canton, China's greatest city, pass through the hands of German merchants. The efforts of German merchants have not been confined to the land alone. The number of ships flying the German flag seen on the Chinese seas and in the harbours of the treaty ports is ever increasing, and this is especially the case on the inland streams. German companies, backed by German capital, are exploiting the coal-fields of Shantung. It is claimed by experts that the coal of Shantung is superior in heating and lasting power to the Japanese coal, and that its use is accompanied by less smoke. This coal is destined to play an important part in the Chinese markets. German capitalists are establishing banks, building docks, factories, mills, and exploiting mines at the present time in nearly every part of China. According to the French Press, the best way to checkmate the increasing influence attending German commercial enterprise in China, in the interest of France, is to construct a railway from Tongking to Yunnan, and thence throuch the heart of China. The commercial activity of German merchants in China, it is added, "should serve as an example and an incentive to French merchants to secure a greater share of the Chinese trade.

OBITUARY.

LORD LINGEN, K.C.B., D.C.L.—Lord Lingen, a member of the Society of Arts of fifty-three years standing, died on the 22nd inst., at his residence in South Kensington. Ralph Robert Wheeler Lingen was born on February 19th, 1819, at Birmingham. He was educated at Bridgnorth Grammar School, and when he went up to Oxford, as a scholar of Trinity College, he possessed a high reputation for his classical attainments. In 1838 he won the Ireland Scholarship, and in 1839 the Hertford Scholarship, in 1840 he obtained a first-class in Classics, and in 1841 was elected to a Fellowship at Balliol. He entered as a student at Lincoln's Inn, and in 1847 was called to the Bar. In 1849 he was appointed to succeed Sir James Kay-Shuttleworth, as Secretary of the Education Department. Twenty years later he became Permanent Secretary of the Treasury, an office which he held with great distinction for sixteen years. On the occasion of the defeat of Mr. Gladstone's Government in 1885, he retired, after nearly forty years service, and was raised to the peerage. In the following year he was made an honorary Fellow of Trinity College, which he entered as a scholar nearly fifty years before. He was created a C.B. in 1869, and K.C.B. in 1878. After his retirement, Lord Lingen did not take any conspicuous part in public life. He was elected an Alderman of the first London County Council in 1889, but resigned his seat in 1892. He was a member of official Committees for publishing a revised edition of the Statutes and the State Trials, and also a Governor of Rugby and Bedford Schools. On April 10th, 1889, he took the chair at a meeting of the Society, when the late Sir Douglas Galton read a paper on the "Sanitary Functions of County Councils."

GENERAL NOTES.

MILAN EXHIBITION, 1906.—An International Exhibition will be held next year to celebrate the completion of the Simplon Tunnel. Attention is drawn in *The Times* to the fact that the time for sending in applications as exhibitors expires (except for live stock, plants, &c., in the agricultural section) on the 31st inst. Application forms and full printed particulars can be obtained in London from the Italian Chamber of Commerce, or through the London Chamber of Commerce. The British Chamber of Commerce for Italy in Genoa is offering every assistance to intending British exhibitors, and is urging the importance of the occasion which the Exhibition offers of comparing genuine first-class British goods with their many misleading imitations. France, Germany, Switzerland, and Austria-Hungary are taking official interest in the Exhibition, and the French Parliament has been asked for a grant of £18,000 for expenses.

NEW CALEDONIA.—Mr. Consul Brophy's report (No. 3431, Annual Series) on the trade of New Caledonia for the years 1903-4 does not suggest a very prosperous or improving state of affairs in the settlement. The island is 250 miles long by an average of 30 miles broad, but the total white population is only 23,000, of whom 12,500 are of free, and 10,500 of convict origin. The town of Noumea contains about 7,000 inhabitants, and of these 2,000 are of penal origin. Agriculture is almost non-existent. Cattle do well, especially towards the

north part of the island, where the pasture is better, but for lack of a good market the cattle breeders are overstocked. Sheep imported degenerate. Nickel, chrome, and cobalt ores are found in large quantities, but owing to the competition of Canadian, Turkish, and other deposits, the prices obtainable leave little profit to the mine owner. The nickel ores of the island are very rich, exceptionally in isolated patches, containing as much as 15 per cent. of metal. In the great Canadian deposits it is only 3 to 4 per cent., but there it is found as a kind of bye product in conjunction with copper, which is not the case in New Caledonia. Of the three large companies working nickel mines in the beginning of 1904, one has suspended operations for the present, having worked out its principal mine at Neponi, and another has closed down its mine at Vohu for want of capital. Something is hoped from the development of coal deposits, and there is a party in the island agitating for a resumption of criminal transportation, but Mr. Consul Brophy sees little likelihood of much early improvement in the economic condition of the settlement.

Foreign Markets.—If Mr. Vice-Consul Dundas is right a good deal more business might be done by British traders with Roumania if they went the right way to work. In his report for 1904 just issued (No. 3432, Annual Series), the Vice-Consul complains that "British firms will not do business except in their own way, and unless they can reap the desired profit." Some British firms, he says, "appear to consider that an advertisement is in itself an oracle, to say nothing of it being in English," and he gives an illustration of British methods in Roumania worth quoting. For some time he has observed—his report is dated June 17, 1905—"a large and expensive advertisement in the main street of Galatz. Unfortunately there is no great demand for the advertised goods, as an inquiry by the firm at this Consulate would have revealed. But the still more unfortunate thing is that the advertisement, being in English, no one understands it. It still hangs on some rough palings surrounded by music hall notices and pictures of music hall singers. It has no connection with such matters, but more than one Roumanian supposed that it was a notice informing the public that a circus was coming from exactly where no one knew, and people went their way no wiser than when they came." The Consul says that no commercial travellers for British firms have called at the Consulate-General during the past two years in order to make inquiries. "There is no American Consulate at Galatz, but this has not prevented Americans travelling for American firms from coming to the British Consulate-General to make inquiries and seek advice."

California and Immigrants.—In his report upon the trade of California (No. 3433, Annual Series), Mr. Consul Bennett points out that before British subjects decide to come to California ordinary prudence requires that the conditions of the country shall be carefully inquired into. Farming in California is different from farming at home, and an experience gained on a British farm is not all that is required to make a successful settler in California. Numberless cases are recorded in the Consul-General's office where British subjects have purchased land in California that they have not seen, with disastrous results to the buyers. If people at home would stay a moment to consider, they would realise that if bargains are offered to them there is something wrong, as Americans on the spot are shrewd enough to pick up anything good on the market. "Land companies," writes the Consul-General, "are not all honest, even though they advertise their schemes in the best London papers, and especially in papers of a religious character, and even representations made in perfect good faith may on personal investigation turn out to be not quite what the reader at a distance thought them to be." The Consul-General advises (1) never to purchase land in California until it has been personally examined; (2) never to buy land at all until you have been in the country at least a year, and have learned all about crops, markets, labour supply, &c.; (3) never to pay a premium to learn farming; (4) take a berth on a ranch for a year or so whilst you look about and gain experience; (5) avoid land companies, land syndicates, and real estate agents; (6) satisfy yourself as to why Americans in large numbers and with considerable capital are leaving California for Cuba.

Industrial Hygiene.—In connection with an exhibition to be held next year at Milan, there is to be a competition of appliances to safeguard against accidents, and the folowing prizes will be offered:—A gold medal and £320 for a new device which will suppress the danger to life coming from a contact formed between the primary and secondary circuits of an electric transformer; a gold medal and £40 for a crane or hoist provided with a simple and practical device preventing the rotation of the cranks on the descent of the load; a gold medal and £20 for a simple, strong, and effective apparatus for automatically stopping cars which are moving upon an inclined plane in case the traction cable should break; a gold medal for a practical device for exhausting and collecting the dust formed during the sorting and cutting of rags by hand; a gold medal for an apparatus for localised exhaust and successive elimination of dust produced during the cardage of flax, tow, hemp, jute, &c.; and a gold medal for an effective device to prevent the diffusion of dust in places where the preparation of lime and cement is carried on. The competition is to be under the auspices of the Association of Italian Industries, and names of competitors must be sent to the Secretary, at Foro Bonaparte 61, Milan, before the end of the present month.—*Nature*.

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FRIDAY, AUGUST 4, 1905.

NOTICES.

SECTIONAL COMMITTEES.

INDIAN SECTION COMMITTEE.

The following is the list of the Indian Section Committee, as appointed by the Council:—

Sir Owen Roberts, M.A., D.C.L., F.S.A. (Chairman of the Council).
Sir William Lee-Warner, K.C.S.I. (Chairman of the Committee).
Sir Frank Forbes Adam, C.I.E.
Lionel R. Ashburner, C.S.I.
Sir Athelstane Baines, C.S.I.
Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.
Thomas Jewell Bennett, C.I.E.
Sir M. M. Bhownaggree, K.C.I.E., M.P.
Sir George Birdwood, K.C.I.E., C.S.I., LL.D, M.D.
H. M. Birdwood, C.S.I., M.A., LL.D.
Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.
Sir Charles H. T. Crosthwaite, K.C.S.I.
F. C. Danvers.
Sir Charles A. Elliott, K.C.S.I., LL.D.
James Fairbairn Finlay, C.S.I.
Lord Harris, G.C.S.I., G.C.I.E.
Colonel Sir Thomas Hungerford Holdich, R.E., K.C.M.G., K.C.I.E., C.B.
Sir Philip Perceval Hutchins, K.C.S.I.
Sir John Jardine, K.C.I.E.
Sir Seymour King, K.C.I.E., M.P.
Henry Luttman-Johnson.
Sir Charles James Lyall, K.C.S.I., C.I.E., M.A., LL.D.
Sir James Broadwood Lyall, G.C.I.E., K.C.S.I.
Sir James Lyall Mackay, G.C.M.G., K.C.I.E.
J. M. Maclean.
General J. Michael, C.S.I.
Sir Patrick Playfair, C.I.E.
John David Rees, C.I.E.
Right Hon. Sir Joseph West Ridgeway, G.C.M.G., K.C.B., K.C.S.I.
Field-Marshal Earl Roberts, K.G., K.P., G.C.B., G.C.S.I., G.C.I.E., V.C.
Alexander Rogers.
Sir Edward Albert Sassoon, Bart, M.P.
W. S. Seton-Karr.
Sir Charles Cecil Stevens, K.C.S.I.
Colonel Sir Richard Carnac Temple, Bart., C.I.E.
Carmichael Thomas.
Thomas H. Thornton, C.S.I., D.C.L.
Sir Charles A. Turner, K.C.I.E.
Alexander Falconer Wallace.
Sir George Watt, C.I.E.
Sir Raymond West, K.C.I.E., M.A., LL.D.
Field-Marshal Sir George Stewart White, G.C.B., G.C.S.I., G.C.M.G., G.C.I.E., G.C.V.O., V.C.
Arthur N. Wollaston, C.I.E.
W. Martin Wood.
S. Digby (Secretary).

COTTAGE EXHIBITION AT LETCHWORTH.

The instructive exhibition of model cottages which the Duke of Devonshire opened on July 25 on the estate of the "First Garden City, Limited," and which has deservedly attracted much attention, owes its existence mainly to the inspiration of an article in the *County Gentleman*. The principal cause of the serious depopulation of the rural districts is, in the opinion of the writer of the article, Mr. J. St. Loe Strachey, the labourer's increasing difficulty in obtaining house-room. When cottages collapse from decay, very few houses of a similar class are built to replace them, owing, firstly, to the cost, and, secondly, to restrictive by-laws. The prosecution by a local authority in Sussex of Mr. Justice Grantham for erecting a cottage that infringed their by-laws, and the demolition of a bungalow erected by another well-known landowner in the same county, have brought the second of the obstacles prominently before the public. "The adoption of these ill-considered and coercive rules and regulations in so many parts of England has," says Mr. Strachey, "not only prevented cheaper cottages being erected within the areas affected by them, but has also checked the application to the manufacture of building materials of the inventive ingenuity and scientific knowledge which, had there been a free field in cottage building, would certainly have been applied to the solving of the cottage problem." Apparently, as a general rule, cottages are not allowed by the rural authorities to be built of other material than brick or stone. It is hoped that one result of the exhibition will be the ultimate abandonment of this narrow limitation. With respect to cost, Mr. Strachey remarks:—"At present a cottage in the country with a garden, which is essential, costs, not counting the land on which it is built, and making the smallest possible allowance for fencing and laying out the site and providing the water supply, at the very least £250, and probably more if the cottage stands by itself, and is not semi-detached or one of a row. But 4 per cent. on £250 means £10 per year; rates account for another pound, and insurance and annual repairs must be placed at at least a pound." Obviously the labourer cannot afford to pay more than £8. Is it possible to build a £150 cottage that can be let for such a rent? A £150 cottage might just be let for £8 a year, not counting anything for site or water supply, which usually, it may be supposed, would be

thrown in. But there is a consensus of opinion amongst landowners that a dwelling providing the necessary accommodation, cannot, under the existing restrictions, be erected for £150. The large and varied collection of houses at Letchworth is intended to show what can be done if the present by-laws are modified. The exhibition is independent of the Garden City now in process of gradual formation on an open, elevated and pretty situation in Hertfordshire; but the local building regulations are anything but restrictive, and the idea is to retain the various structures for permanent use. The cottages built for competition number over 70, of which 50 are single and the rest in pairs or groups of three and four. Numerous substantial prizes are offered both for the permanent buildings and designs, the latter being shown in the spacious sheds erected for the accommodation of the unemployed who were taken down from London for road-making. In the former category the first prize (£100) is offered for the £150 cottage, detached, and complying with the following requirements:—(1) Number of living rooms —one living room and scullery or kitchen-scullery. (2) Height of living rooms—not under 7 feet 6 inches. (3) Number of bed-rooms—three, with two fireplaces. (4) Height of bed-rooms—not under 7 feet 6 inches. (5) Cubic space in bed-rooms—2,000 feet. Class II. Best pair of five-roomed cottages (including scullery or kitchen-scullery) erected at a cost not to exceed £300. Class III. Best group of three or four cottages, cost not to exceed £35 a room. Class IV. Best detached cottage or pair of cottages, cost not to exceed £35 a room. The net cost in each case to be exclusive of architect's fees and builder's profits.

One of the points to be taken into consideration by the judges is durability, the importance of which in a climate like ours was insisted upon by the Duke of Devonshire in his eminently practical speech. The special correspondent of *The Times*, in describing the private view, suggests that the £150 standard has been too prominent, "The result seems to be that most of the architects and builders have laid themselves out to produce the prettiest thing they could for the money, not to produce a sound and serviceable dwelling for the lowest possible cost, which I understand to be the real object in view. The general impression is less of genuine labourers' homes than of tasteful little week-end or summer holiday cottages for town-dwellers whose means do not run to a country house, but who can afford a modest *pied-à-terre* amid rural surroundings. There is a great and growing demand for such cottages, and in some districts it is responsible for a good deal of the native displacement and for rising rents. The present exhibition contains many charming specimens which will appeal to persons of taste in search of a cheap and pretty rustic roof-tree, and no doubt it will stimulte building among that class. This is very well, but it is not the same thing as housing the rural population." Some who have visited Letchworth will be inclined to agree with this criticism, but certain of the cottages are plain enough for anybody, and, what is more important, there is no lack of variety in the materials employed. For example, one artistically conceived and admirably-arranged cottage is built principally of timber on concrete foundation, the "weather-boarding" being treated with carbolineum to prevent rotting. In the case of another exhibit the brick walls are covered with Portland cement and rough cast. Amongst the special prizes is one of a hundred pounds, given anonymously, for the cheapest cottage in the exhibition. consideration being had to its soundness and suitability for a rural labourer and his family. The area of the Letchworth property is extensive, close upon 4,000 acres, but the chief exhibits are conveniently grouped together in a spot near the Icknield Way, the ancient Roman road that extended from Yarmouth to Land's End, and quite near to the new station that has been recently opened by the Great Northern Railway on the main line from London to Cambridge.

The number of the *Building News* for July 28th contains a notice of the cottages erected at Letchworth with illustrations of several of them. The writer says that "in the opinion of Messrs. Parker and Unwin, who are acting as advisory architects to the Garden City Company, the problem is rather 'How cheaply can we build a good cottage?' than 'How good a cottage can be built for £150.' In their opinion, if a good cottage cannot be built for £150 there is no insuperable reason why the sum should not be increased to £175, this being merely a matter of 6d. per week adjustment in rent and wages." The writer adds, however, that this is the crux of the whole matter. "The labouring man is in this position:—that his employer will not under any circumstances pay him more than his present wage, while his landlord cannot let him his cottage at its present rental. The wage being already so low that no further economy is possible in clothing or in food, it is difficult to see how the extra sixpence per week demanded by the landlord is to be found."

The writer, referring to the materials used in the building of the cottages, says of Mr. V. Dunkerley, one of the exhibitors:—"He has used two new materials, employing the rapid and smooth-setting Pytho plaster for his wall surfaces, and asbestic bricks for his walls. These are composed of lime, sand and asbectic, and are machine-made and steam dried. They are made in many colours, and are hard and true of arris, and ring well." Of other materials, the writer mentions "expanded metal, wire-wove roofing, the mack partition, and uralite, while many of the houses are of timber construction entirely. All have red-tile roofs."

It is worthy of note that in 1863, when the Society of Arts offered special prizes for designs for cottages for the labouring classes, these prizes were "for the most approved designs for cottages with three bedrooms in each, to be built singly or in pairs, at a cost not exceeding £100 each."

DIAMONDS AND THE DIAMOND INDUSTRY.*

In 1475 Louis de Berquem invented the great art of diamond polishing, and in 1476 established at Antwerp the earliest known works for the purpose of cutting and polishing diamonds. The disturbed state of that part of Flanders drove the diamond industry to Amsterdam, where it flourished uninterruptedly for upwards of three centuries. It was not until the independence of Belgium was established in 1830 that Antwerp began to recover its position as the headquarters of the diamond industry. After the discovery in 1870 of diamond mines in Cape Colony, the wages earned by skilled workmen at Antwerp increased to so great an extent that some of the workmen are said to have earned wages amounting to as much as from £40 to £48 a week. Since that time the diamond trade of Antwerp has continued to increase in importance, and it now equals that of Amsterdam. The whole European diamond trade is centred in these two towns.

Diamond cutting is divided into three separate and distinct processes—(1) cleaving, (2) brutage, (3) cutting and polishing. Cleaving is the act of dividing the layers or scales which form the crystal, an operation which can only be performed in one manner on account of the flaky formation of the diamond. The stones have to be divided in accordance with the running grain of the carbon of which they are composed, and any attempt to divide them in another way would result in their being split and destroyed. A diamond is cleft as follows:—The rough stone is placed in a small metal receptacle, with the side of the diamond which it is desired to cut facing downwards. Over this receptacle is placed a shaped mould which is securely attached to it. Into the top of this mould is then poured liquid aluminium, which runs into the shape of the mould and, after being cooled, securely holds the diamond in the required position. The mould is then removed and the stone remains fixed in the aluminium ready to be applied to the cutting tool. The machine used for the cleaving is a small circular saw of about four to five inches in diameter, which rotates at a high rate of speed and is driven in the ordinary way by a leather belt from the running machinery. The saw itself is made of fairly soft copper with a prepared edge. To prepare the cutting edge of the circular saw it is necessary for it to go through a special process by which diamond dust mingled with oil is forced into its edge. "Diamond cuts diamond" as, after the preparation of the saw, its cutting edge is embedded with minute grains of diamond dust. The diamond is then applied to the saw in a similar manner to that in which wood is placed against a circular saw in a mill with the slight difference that the diamond is held immovable in an instrument overhanging the saw which presses it gently against the blade. It frequently takes two weeks continual work to cleave a diamond, the duration of the time depending entirely on the hardness of the substance of the stone to be cut. The most difficult stones to cut are those of double formation, the grain of which is interlaced, thereby creating greater resistance. The machine used was invented some years ago in America by a Belgian who was at the time working in the United States. Before its invention diamond dust for the finishing process was often most difficult to obtain, and manufacturers had frequently to grind fragments of inferior diamonds by means of a hardened steel pestle and mortar, but nowadays the supply of diamond dust is always abundant, not only "for the requirements of the factories, but even to be disposed of for use in other industries, such as glass-cutting." Before the coming into use of the machine referred to, the whole of the process of "brutage" had to be performed by hand, and was most monotonous and tiring work, the shaping of larger stones in particular necessitating a great loss both in time and labour.

The second process in the preparation of a diamond is its primary formation before it is ready for the first cutting and polishing, and the operation is carried out by means of mechanically rubbing one stone against another until the desired formation is achieved. Before the "brutage" takes place the stones are received either in their rough state, save that they have been washed clean, or else from the cleaning department in so many small pieces. The mode of procedure is as follows:—Two diamonds may be taken of similar size and equally hard in substance. Each stone is fitted into a brass or other metal cap by melting cement in a gas flame, which is then dropped into the aperture of the cap, the diamond being fixed in the cement, which is afterwards cooled and set by being plunged into cold water. Thus, two diamonds of equal dimensions are firmly fixed each in a separate metal cap or holder. One of these stones is then attached, by means of the cap which holds it, to a rotary machine, the stone forming the revolving centre. The other stone is fitted to a long handle or holder, and is placed against the revolving stone in the required position in a similar manner to that in which the tool is applied when cutting wood or metal in a lathe. The diamond dust which is produced by the rubbing of the stones together falls into a copper box called an "Eglisoir," or diamond dust box, which is placed immediately below the diamonds being worked. This dust is carefully preserved, and it is eventually used in the third operation of cutting and polishing.

Cutting and polishing is the third and last operation in the preparation of a diamond previous to its sale. In this process the stone, which has been roughly shaped by the second operation, is placed in position at the required angle in a copper holder with

* The statements of fact made in this paper rest upon the report of Mr. Consul-General Hertslet on the diamond industry of Antwerp, just published (No. 631, Miscellaneous Series).

which it is firmly pressed by means of a forked clamp, which is pressed against the stone and locked into position with a key. Great skill is required on the part of the workman in fixing the diamond into the holder. Many stones of one-eighth of an inch and less in diameter, weighing between 1 and 2 grains, have as many as 50 to 100 facets or separate cut faces, each at a different angle. Continual practice, however, facilitates this operation, and a skilled workman can immediately place the stone in the holder at the required angle ready for the cutting of another facet. When the stone is ready in the holder it is placed against a revolving disc of soft steel rotating in a horizontal position at a speed of some 3,000 revolutions a minute, and is left there until the required facet is cut and polished. The surface of this disc is prepared with a mixture of diamond dust and purified olive oil, which is rubbed into the steel, and it is this dust, which comes in the form of waste from the second operation of "brutage," that effects the polishing of the stones.

In olden times diamond cutters contented themselves with cutting as large a number as possible of small facets on the surface of a stone, regardless of regularity, and without taking into account its form or size, but it is now recognised that to obtain the best results and sparkling glitter, a diamond must be cut in a regular form, so that one surface may reflect on another thereby showing forth the hidden light and beauty of the stone. There are two common forms of cutting diamonds, it may almost be said there are only two forms, the brilliant and the rose, the brilliant for stones of a certain uniform thickness, and the rose for flatter stones and layers which have been cut from other and larger diamonds. The cutting of a brilliant is the process which best shows forth the lights and reflections contained in a diamond. A perfectly formed brilliant should have the proportions in depth from the upper surface or summit to the lower point called the pyramid or pavilion of two-thirds of the diameter of the stone at the belt or middle. The summit, or crown, of a brilliant should have 32 facets, and in addition one large central facet called the table. From the side of the pyramid it should have 24 facets and one small facet at the lower point called the "colette," making in all 58 facets, and not, as has sometimes been stated, 64 facets. These facets should be calculated, divided, and regularly cut in such a manner that those cut on the pavilion of a diamond may reflect the light on to the facets cut on the summit, and *vice-versâ*, thus showing forth in as high a degree as possible the sparkle and glitter of the gem. All diamonds are cut in a series of stars, one being formed over the other. On looking through the flat surface, or table of a properly cut brilliant the "colette" or lowest point should appear to be directly in the centre of the table. In the regular cutting of these facets depends the whole beauty of a diamond, and in their formation lies the secret and difficulty of the diamond trade. The rose is a more usual form of cutting diamonds, of less value and thinner formation, and is cut with one large facet at the base and 24 triangular facets on the summit. The thicker stones cut in this manner, with 24 facets, are called on the Continent "Roses Couronnées." Those which are only cut with 12 or six facets are known by the name of "Roses d'Anvers," and form one of the chief specialties of Antwerp. The quality and value of a diamond may be roughly determined by examining it against the light. In a stone of inferior value there appear to be many lines or scratches, whereas the more perfect stone is recognised by its purity and lack of marks in the grain, and also by its regularity of formation.

The bulk of the diamonds worked in Belgium and the Netherlands originate from British possessions, or mines owned by British subjects. The diamonds, after being cleaned and weighed in their country of origin, are sent to merchants in London, where they are sorted and put up for sale. The stones are then invariably purchased by foreign merchants who have their factories abroad. Thus although the stones come first to the United Kingdom, they are afterwards conveyed abroad to be cut and prepared, and then in many cases returned to the United Kingdom to be sold by retail dealers. By this practice the whole of the diamond industry, with its profits, is lost to the United Kingdom. It can hardly be said that low wages prevents British competition in the diamond industry. The average wage paid to diamond workers at Antwerp range from £2 12s. to £2 16s. per week. The diamond cutters are paid from £2 8s. to £3 4s. per week, the shavers from £4 per week upwards, and the sorters are paid wages varying from £1 5s. to £2 per week. The workers employed in all the branches of the industry at Antwerp, number from 4,000 to 5,000, including some 70 women employed on the lighter work. No precautions are, or can be taken, to guard against dishonesty in the workers, but cases of dishonesty practically never occur. It is difficult to state the names of the countries to which diamonds cut at Antwerp, are sent, or the value of the stones exported, as no statistics on the subject are published. A diamond is so small an object, and one of so great value, that practically all the diamonds exported are sent out of the country without the knowledge of the Customs officials. In the Customs returns for 1903, is a note which states that owing to the existing conditions of the export of cut diamonds it is impossible to give details of their value, but that from information received, it is estimated that the value of the exports during that year amounted to £3,340,000. Precious stones are admitted free of duty in Belgium, and there seems to be no sufficient reason why this valuable industry should not be carried on in the United Kingdom. It ought to be possible for the British workman to learn the art of diamond cutting in spite of the secrecy adopted by the diamond cutters as to their method of working.

THE SOUTH WALES COALFIELD.*

A good deal has been said during the past two weeks regarding the reported acquisition by a German Syndicate of a steam coal area in South Wales. Many of those who have said so much would have done better to make themselves acquainted with the actual facts of the case. Fortunately this is a very easy matter. In a supplemental report issued some time ago by the Commission on Coal Supplies, and printed in the *Iron and Coal Trades Review*, the subject of the South Wales coalfield—one of the largest, and, having regard to its extent, the quantity and unequalled qualities of the steam coal, it contains the most important of the coal resources of this country—has been most ably and completely dealt with by Sir William T. Lewis, a member of the Commission, who unquestionably, from his prominent position as a colliery owner, his acknowledged eminence as a mining engineer, and his intimate knowledge of this great coalfield, was best qualified for the important work entrusted to him by the Commission. There are separate reports which deal with the relatively small and neighbouring coalfields of the Forest of Dean, Somersetshire, and Bristol, but I shall confine myself to the South Wales coalfield, and more especially to that portion of it in the county of Glamorgan, from which, as will be seen from one of the tables in the report, nearly 70 per cent. of the total annual coal output of the coalfield is at present derived, nearly half of which (47·31 per cent.) is shown to consist of steam coal.

The discovery of these steam coal seams, which has led to the enormous development of the Welsh coal industry during the last 33 years, and which has made Cardiff what it now is—the chief port of export in the kingdom—is well worthy of mention, and has a direct and important bearing upon the question of the duration of our coal resources.

Speaking from my own knowledge and long experience of colliery working in Wales, I should, in the first place, mention that the coal seams previously almost exclusively worked were the upper and bituminous coal measures. The coal obtained from them, other than that used for domestic purposes, was ordinarily converted into coke for blast furnaces, and nothing but coke was then, by statute, allowed to be used for locomotives on account of its smokeless character. Many English and French railways were then supplied with coke from the Welsh collieries, some of the colliery owners having their own coke ovens at Nantes and other French towns, and the coal being sent there to be coked.

As regards the discovery of steam or "smokeless" coal, as it was termed, the following were the circumstances as narrated to me at the time by the late Mr. John Nixon, to whom, in a great measure, we owe the development of the coal industry and the first introduction of Welsh coal into France and other foreign countries. He told me he was then the agent in France for one of the Welsh colliery owners, and, happening to be in London and on board one of the Thames river steamboats, he noticed the engine-man looking up at the funnel of the steamer and shouting down to his mate below, "No smoke." Failing to learn the cause of the "no smoke," Nixon succeeded by tipping the engine-man a half-sovereign in ascertaining that he and his mate were testing some "smokeless coal," as he termed it, obtained from some unpronounceable place in Wales, and, after satisfying himself as to its smokeless character, Nixon said he visited the locality whence it came, and found the coal was obtained from one of the many fine steam coal seams, now well known to underlie at great depths the upper and bituminous seams already alluded to. The pioneers, however, in the working of steam coal, and who first introduced it for steam and other services to London, were the Thomas family, of Waunywllt, the unpronounceable place alluded to in Nixon's story.

In Sir William Lewis's report full particulars are given of these steam and other coal seams, with a table giving their varying number and aggregate thickness in different parts of the coalfield. In the county of Glamorgan, from which, as already stated, about 70 per cent. of the total annual output of coal of the entire coalfield is at present derived, there are, in some parts of the coalfield, as many as 42 seams, with an aggregate thickness of 124 ft. 6 in. of workable coal; in other parts 67 seams, with an aggregate thickness of coal varying from 94 ft. 6 in. to 84 ft. 10 in.; 52 seams, with an aggregate thickness varying from 70 ft. 11 in. to 66 ft. 8 in.; and 14 seams, of an aggregate thickness of 65 ft. 11 in. The exact average aggregate thickness of the coal seams in all parts of the county (taking into account the number of each group of seams) is 91¼ feet of workable coal, while the average aggregate thickness of the coal seams throughout the entire coalfield is exactly 78 feet, irrespective, however, of the extent of each coal-bearing area.

Although the number and aggregate thickness of the workable coal seams in different parts of the coalfield as shown in the report afford a very good idea of the great extent of the coal resources of the Glamorganshire portion of it, they do not, in the absence of the necessary information as to the extent and position of the respective coal-bearing areas, enable the quantity and average aggregate thickness of the coal seams throughout the entire coalfield to be correctly ascertained. The table given, however, affords a striking illustration of the extreme care and judgment shown in ascertaining the correct coal-bearing areas throughout the entire coalfield. A comparison of the 78 feet average aggregate thickness of the coal seams as obtained from it (irrespective of the extent of the various coal-bearing areas) with the actual average thickness

* Article by R. Price-Williams, from the *Iron and Coal Trades Review*.

of 37·21 feet* as deduced from the statement in the report that the total area of the coalfield is 1,000 square miles, or, in other words, 640,000 acres, and that an acre of coal 1 foot in thickness represents 1,500 tons of it, shows that the 35,723 million tons of coal estimated in the report as remaining unworked in this coalfield owing to limitations in the coal-bearing areas, has had its average aggregate thickness of seams reduced to the lesser figure.

Accompanying the report there is an excellent geological map showing the extent of the coalfield, with the position marked upon it of a number of sections of typical strata, and showing the number, depth, and thickness of the different coal seams. The extent of the let and unlet coal areas has also been carefully ascertained, and with all this valuable data and a great deal more derived from an intimate knowledge of this great coalfield, Sir William Lewis has furnished the Commission with a most valuable and reliable estimate, from which it appears that the total available coal resources of the entire coalfield, after making full allowance for loss in working, due to coal left underground, faults, and other causes, including a deduction of 5 per cent. for consumption in raising the coal are, roundly speaking, 26,919 million tons, or considerably more than one-fourth of the total available coal resources of the United Kingdom.

As a striking illustration of the magnitude of these coal resources it is pointed out in the report that, taking the output of 364¾ million (364·72) tons during the last ten years (1894-1903, inclusive) as a measure, it would take 738 years with that maximum decennial output to entirely exhaust them. These figures, however, are obviously not put forward as an estimate of the probable duration of these large coal resources, inasmuch as side by side in the valuable table of the annual outputs of coal in the entire coalfield the average rates of increase during the last 33 years are most correctly given, from which it appears that the decennial rate of increase varied during the last 30 years from a maximum of 56·23 per cent. per decade, or 4½ (4·56) per cent. per annum to 31·1 per cent. during the last decade, or 2·34 per cent. per annum. The average rate, however, during the whole period of 33 years was as much as 41·31 per cent. per decade, equivalent to 3½ per cent. per annum, a rate which, if maintained, would exhaust the whole of the available 26,919 million tons of coal in considerably less than 100 years, as the total output of coal during that period as calculated at that rate would be 35,271 million tons.

The average rate of increase of the total output of coal does not, however, give anything like a true idea respecting the different classes, the output consisting of two distinct items, home consumption and export coal, each differing largely in quantity and in rate of increase.

The export coal is not given separately in the Tables in the report, owing to the fact that the ports of export for the coal outputs from some of the counties are indeterminate. I have, however, been able to ascertain from the annual coal export Tables given in the appendices to the report of the Commission (Part XI.) the annual coal exports from the ports of the entire coalfield, and also from the Glamorganshire ports, from which county alone, as already stated, 70 per cent. of the coal output is derived, and I have prepared a Table showing the home consumption and export coal separately, with their respective rates of increase during the 33 years dealt with in the Tables in Sir William Lewis's report. The results obtained are very striking, and afford all the requisite data for correctly ascertaining the past average rates of increase and the decrements in those rates during the period in question of both the home consumption and export coal.

Although, as in the case of the output of coal in the United Kingdom, the rates of increase of the home consumption and export coal differ greatly, I find the decrements in the respective rates have, during the period dealt with in the report, been exceptionally large, more especially in the Glamorganshire portion of the coalfield, which with portions of Carmarthenshire and Breconshire contain nearly 90 per cent. (89·71 per cent.) of the total resources, and produce 70 per cent. of the annual coal output of the entire coalfield. The home consumption coal, in this portion of the coalfield, has of late been increasing at a comparatively slow rate, and in quantity it is now largely exceeded by the export coal, which more than trebled in the first two decades, and, although still increasing, is doing so at a much less rapid rate. It is, in fact, the exceptionally large decrements in the rates of increase of both the export and home consumption coal which constitute the remarkable and most hopeful circumstances in connection with the future duration of these coal resources, inasmuch as their continuance, in spite of the large increase in the coal exports, would, as the following brief tabular statement shows, result in prolonging the duration of the coal resources in this portion of the South Wales coalfield, which contains the great bulk of these precious seams, for at least three centuries and more, beyond the period of 100 years and less, which (with the continuance of a constant rate of increase of output of 3½ per cent. per annum) would inevitably witness their complete exhaustion. I would add that the effect of these exceptionally large decrements in the rates of increase, mainly due, as already stated, to greater economy in the working and consumption of coal, would be to reduce the rates of increase to a nominal figure, in the short space of a hundred years, as shown in the statement. There appears, therefore, to be everything to justify the belief that with the further important economies which the Coal Commission consider practicable, there will be no actual decrease in the coal output in this portion of the coalfield for a much longer period.

$$* \frac{35{,}723{,}000{,}000}{640{,}000 \times 1{,}500} = 37{\cdot}21146 \text{ ft.}$$

SUMMARY OF FUTURE COAL-OUTPUTS IN GLAMORGANSHIRE.

—	Rate of increase per decade 1890–1899 = 13·96 per cent. Average decrement = 40·63 per cent.	Rate of increase per decade 53·83 per cent. Decrement = 48·31 per cent.	Total output.
	Tons.	Tons.	Tons.
1st century	1,327,482,200	1,912,734,000	3,240,216,200
2nd ,,	1,364,859,500	2,023,725,000	3,388,584,500
3rd ,,	1,364,859,500	2,023,725,000	3,388,584,500
4th ,,	1,364,859,500	2,023,725,000	3,388,584,500
	5,422,060,700	7,983,909,000	13,405,969,700

In conclusion, I would point out that, although the total quantity of coal calculated to be worked out in the Glamorganshire portion of the coalfield (in the event of these large decrements in the rates of increase of output being maintained) only amounts to about half the total available coal resources of this portion of the coalfield, the quantity, by a mere coincidence, is almost exactly what Sir William Lewis estimates as the total available amount of our Welsh steam coal resources, viz., 13,407 million tons. It is, however, to be hoped that in what will remain of the available coal resources in this portion of the coalfield, when that half has gone, the greater portion will consist of steam coal.

THE MANUFACTURE OF COGNAC BRANDY.

Pure cognac brandies are distilled from wines produced in the Cognac region, the Charente and Charente Inférieure, and are classed in quality by the district from which the wine comes. There are the "fine champagne," the "petite champagne," "borderies," "fins bois," "bois ordinaires," and "bois communs." The "fine champagne" is grown in a district of France directly to the south of Cognac, comprising half a circle, of which Cognac is the centre. The "petite champagne" is grown in a district which would be enclosed between the first half-circle and a larger one paralell to it, at a distance of several miles. The "borderie" is produced in a triangular portion of territory immediately to the north, and slightly to the west of Cognac. Surrounding these areas, but extending a greater distance to the west and to the east, is the region in which is produced the "bois ordinaire," while the "bois commun" is produced between the last-mentioned district and the coast, directly to the west and the south-west. The "bois communs" are also produced on the islands of Ré and Oléron. The wines are distilled under three different auspices. (1) By the "bouilleur de crue," a vineyard owner who distils his own product and sells it to the manufacturer. He usually possesses one still and sometimes two. (2) The "proprietaire," who distils his own product and that of his neighbours, from whom he may buy the wine, or for whom he may distil for remuneration in kind. The "proprietaire" may possess four to eight stills. (3) The "merchant" who owns many important distilleries, wherein are reduced to brandy the wines from his own vineyards and purchased wines. When the wine is bought, the producer is paid in accordance with the degree of alcohol contained. The merchant may have sixteen or even twenty stills in each of his establishments, with a capacity for reducing 40,000 to 50,000 hectolitres (880,000 to 1,100,000 gallons) of wine into brandy during the season.

The methods of distillation vary greatly with the kind of wine, the district, and the person who has charge of the distillery. The United States Consul at La Rochelle says that, as a rule, all Cognac wines are distilled with the lees. The stills employed in the champagne district are usually simple pot stills, with or without "chauffe-vin." The simple still consists of the "choudière," or boiler, the "chapiteau" which connects the boiler with the third part, and the condenser with its serpentines. The "chauffe-vin" is supposed to be an improvement on the simple still, by which several hours may be saved on each operation. It consists of a reservoir connected with the boiler, through which passes the pipe of the "chapiteau" containing the hot vapours of the wine, which warm the wine to a degree just under that necessary to produce vapours in sufficient quantity to be condensed. Consequently, when the boiler is emptied it can be refilled at once with wine at a temperature high enough to begin to give off vapours at once when over fire. The boiler is filled with wine by means of a pump, if the still has no "chauffe vin," and from the "chauffe vin," if having one. The boilers contain usually about 500 litres (110 gallons) and the liquid is evaporated by an urn, but mild heat, which is continued until the alcoholometer indicates that the distillate contains O alcohol. At this time it is found that from one-fourth to one-third quantity of wine has passed through the condenser and this distillate is called "brouillis."

In the small distilleries, a still is filled three times before enough brouillis is obtained to commence its redistillation. In the larger distilleries the products from three stills are united in a single still, and another or second distillation commences, by which the brouillis is converted into brandy. This is called la "bonne chauffe." The "bonne chauffe" is divided into three or four sections as follows:—Five per cent. of liquor which leaves the still possesses a highly disagreeable odour, due to excessive quantities of concentrated aldehydes and acetic ethers, of a colour often greenish or white called "la tête," or heading, which is taken into a receptacle and kept apart from that which follows. The quantity may exceed five per cent., depending on the nature or quality of the wine. These headings are later mixed with another brouillis, or with what is called "seconds." This alcoholic heading, in condensing, has washed the interior of the serpentine

and has removed certain oily matters which remained in the spiral from the preceding distillation. The part of the distillate which follows, known as the "cœur," or heart of the "bonne chauffe," is clear, and consists of from 80 to 85 per cent. of alcohol. The "cœur" continues to run into the same receptacle until the alcoholometer indicates that the liquor leaving the still contains 50 per cent., or perhaps 55 per cent., of alcohol, according to the wine. When properly carried on, this process lasts about eight hours, and the liquid contains from 66 to 70 per cent. of alcohol. This product is brandy. The distillation, however, is continued until again the alcoholometer registers O alcohol. The product of this third part of the distillation is called "queue," or tailing, and is generally added to the next lot of wine placed in the still. It contains from 20 to 24 per cent. of alcohol. Sometimes, however, when the wine is very rich in alcohol a fourth is produced, which is known as "seconds," and consists of that part of the operation wherein the distillate reduces its strength from 60 to 20 degrees. These seconds are usually added to the next brouillis, while the remainder of the alcohol obtained—that is, from 20 degrees to O, which in this case is the tailing—is mixed with the next batch of wine. The seconds require about four hours of distillation, which makes the entire process last about twelve hours. This length of time of course applies to the "bonne chauffe." The quality of the brandy produced may depend very largely on the purity of the copper, of which the boiler, "chapiteau," and serpentine is composed, as it has often been remarked that the oily acids attack the metal and bring away in the distillate very perceptible quantities of copper compounds, which are disagreeable to the taste and are probably dangerous to health. Length of time taken may also mean much. Wine distilled too rapidly may force its fumes too quickly through the serpentine to be condensed, and consequently some of the elements most volatile may escape. Again, the point where the heart is separated from the tailing during the "bonne chauffe" may influence the taste and quality of the distillate. Certain of the superior alcohols pass earlier in the evaporation and the others later.

There are also what may be described as compound stills. These were invented with the object of producing brandy direct from wine in one operation or distillation. The principle of all these stills is that of a "chauffe-vin" and boiler combined, in such a manner as to obtain the complete condensation of vapours which leave the boiler, thus producing a brouillis, which in its turn is re-distilled. The condensation is generally effected by the "chauffe-vin," and the brouillis is collected in another or secondary boiler, in which is enclosed the larger one. The heat, which is furnished by the alcoholic vapours of the boiling wine, produces a distillation of the brouillis, the vapours of which in their turn, are sent into the serpentine and condensed into brandy. There are very large numbers and varieties of these compound stills, which are used only in the country of the "bois," where wines contain very much less aroma, and have a peculiar taste which is called "terroir," or savouring of the soil. The brandies produced from the bois wines, are usually mixed or blended with the highly aromatic brandy of the "champagne" or of the "borderies" districts. Much might be written descriptive of the various compound stills, which although unchanging in principle, becomes more and more complicated as distance increases from Cognac, the centre of the brandy trade. The most complicated ones are used in the districts of the "bois communs," and especially in the islands of Ré and Oléron. The United States Consul give the following description of the method of distillation as practised at one of the most important distilleries he visited. The boilers were filled twice in twenty-four hours. In the morning, half of the sixteen stills were filled with wine, and had produced by evening the impure alcohol known as the "brouillis" or "flegme." In the evening all the boilers were filled with wine, and the next morning they had produced the brouillis. All of the brouillis collected the evening before, and the morning following, from twenty-four different stills, is divided, and placed in eight of the sixteen stills, and is submitted to a re-distillation or rectification called "doubling." The other stills are filled with wine, as on the morning of the day before, in order to combine the process regularly and without interruption in the same manner during the entire season. By this system each man is charged in the morning with the filling of one boiler with brouillis, and one with wine; in the evening two boilers with wine. This idea is the direct result of the quantity of brouillis produced by the distillation of wine, *i.e.*, one-third so that three boilers must be filled with wine and distilled by each man in order to have sufficient brouillis to fill a single boiler and commence its rectification. Each time a still is filled and each time its product is obtained, whether brouillis or brandy, a declaration is made upon a register which is kept continually at the disposition of the Government régie. Each barrel of wine before it goes to the still is numbered, and the still into which it goes must be known; its degree of alcohol is also inscribed in duplicate on a register, one copy of which is placed in a box of which only the officials of the régie have the key; the other copy remains on the register. The amount of brandy produced from that particular barrel of wine must be in proportion to its alcoholic strength, and a register of the quantity obtained in brouillis, is kept in the same manner as for the wine. When the brouillis in its turn is distilled, a corresponding record is kept of it, and of the brandy which it produces. The products are placed in casks, each of which is numbered, and the quantity and strength of alcohol therein is also indicated on the barrel. This alcohol cannot be removed from the premises, neither can any

alcohol be brought to the premises or carried from one portion of a town or city to another without a permit from the régie, of which permits careful records are kept. The permits indicate by their colour, white or pink, whether the alcohol represented by them is wine or some other source than wine. It can be readily understood that this system renders the manipulation of alcohol exceedingly difficult to persons who desire to use it, and conceal the fact. The residues of the wine which is left in the still, after the brouillis has been produced may be used for the manufacture of fraudulent liquors, but at Cognac it has been found recently that it is much more profitable to denature these residues with lime in order to produce tartar salts, which contain from 48 to 52 per cent. of pure tartaric acid. Formerly, when the vintages were very small, owing to the ravages of the phylloxera, many irresponsible people added to the wine they distilled, rectified spirits produced from beets. The large quantities of wine produced in the last four years make this proceeding practically useless from a financial point of view. It is further rendered exceedingly difficult by the new regulations of the French Government represented by the régie.

THE HOUSING QUESTION IN GERMANY.

The housing question in Germany presents much the same problem for solution as in the United Kingdom. The migration of the people to the towns consequent upon the growth of trade has increased enormously the population of the towns, especially of those with more than 100,000 inhabitants, and housing accommodation has not been equal to the demand. Thus in April of the present year there was, says Mr. Consul-General Oppenheimer in his report on the trade and commerce of Germany just issued (No. 3,445, Annual Series), in Frankfort, 133 single room lodgings available for 554 applications, so that not even one-fourth of the demand could be satisfied. The disproportion between demand and supply of apartments of two rooms was even greater. Only one-sixth of the demand could be met, and in the case of three-room apartments half the number of applicants only found what they sought.

The annual increase in the population of Germany numbers 800,000. These, as well as those already in existence, must be housed properly, and most of them must be housed cheaply. The rapid increase of the population has caused a rise in rents generally, so that as with the similar classes in the United Kingdom, the poorer classes are spending a constantly increasing percentage of their income in the payment of rent. Delay in the solution of the housing question is dangerous in so far as it complicates the possibility of any remedies, for space is limited, and as far as it is required for cheap housing difficult to replace once opportunities have been missed. What were suitable and available sites only a few years ago have been bought up by the speculative builder, who has produced luxurious houses along luxurious streets. Then the prices of building materials have risen, wages are higher, and the value of sites has increased. The Imperial Treasury has spent 15,000,000 marks since 1901 for the purpose of providing housing accommodation, but this expenditure was practically limited to cheap apartments supplied for Imperial officials at low salaries. The Home Office has in some instances encouraged the building of small apartments by letting sites on prolonged leases (Erbbaurecht) at reduced rental under the condition that artisans' dwellings be erected, but often, as in the case of Schömholzer Haide, in the north of Berlin, it has disposed of Treasury lands to builders and others at the best possible price though suitable for cheap lodgings, and has thus missed rare opportunities. Many of the large factories have spent great sums in supplying their workmen with lodgings, often model dwellings. In some instances the area covered by such dwellings practically equals that of large villages, as in the case of the chemical works at Höchst, but the objection to the system lies in the fact that the tenancy ends with the contract of labour, and the workmen are thus easily robbed of the possibility of an independent attitude in questions arising between employer and *employés*.

In some parts of Germany building societies of a charitable nature were started with the purpose of building cheap dwellings for the workmen. Thus in Rhenish Prussia there exist 117 such building societies. The number of houses supplied by the societies amounted, up to April 1904, to 4,242, containing 9,020 lodgings; 62·5 per cent. were built for sale, the others for letting. Both kinds were chiefly built on the plan of admitting two families. The rents are on an average 20 per cent. cheaper than the ordinary local rents. In the houses for sale the workman live more cheaply too after the deduction of the payments made to capital account. Yet the financial position of the societies is in most cases satisfactory—71 of them paid an average dividend of 3·2 per cent. If the 9,000 families thus housed are on the average calculated to consist of five persons, 45,000 to 46,000 persons in Rhenish Prussia owe to these building societies healthy and clean houses, from which there is small danger of ejectment, and where there is no fear of increased rents. But it was only when a Bill was put on the table of the present Diet that an attempt was made to provide a remedy uniform for the whole kingdom.

The bill in one of its parts devises means to remove the causes which have so far deterred the builder from erecting small lodgings. The speculation in sites which is the chief reason of the present high rents is rendered impossible by provisions concerning the planning of the streets, the building plans, the frontage line, &c. Whereas the present building plans generally favour deep sites, very wide streets,

and consequently buildings, with a great number of apartments and courtyards, the new building plans are to be devised on a footing corresponding to the requirements of the district, so that quarters that are suitable for small lodgings shall be mapped out in shallow sites and streets of lesser width. As an inducement to the building of small lodgings the contributions towards the road-making are to be considerably reduced in all cases in which healthy and appropriate lodgings are built for the housing of families of small means. Another part of the Bill regulates the police intervention in the case of bad and crowded apartments. In communities of 10,000 inhabitants and more, it is proposed to compel the police to frame lodging bye-laws, and to give them power to frame such bye-laws for communities with less than 10,000 inhabitants. These bye-laws must regulate air-space, the separation of the sexes, the sleeping accommodation of *employés* and servants, &c. Provisions are also made for the inspection of lodgings by special officials, the communities with more than 10,000 inhabitants being forced to appoint a Lodging Board, consisting of competent persons, to carry out such inspection. Thus the Bill tackles the housing question from three different points:—(1) By means of building plans and building regulations; (2) by means of reduced taxation; (3) by the introduction and supervision of minimum demands concerning hygiene and morality. It is thought, however, that it does not go far enough. The provisions for cheapening of lodgings are considered by many to be insufficient; the reduction in the contribution towards road-making is considered inadequate inducement to the builder; it is held that the lodging bye-laws should be made compulsory in all communities instead of permissive where they do not number 10,000 inhabitants, and the question of windows has been entirely ignored. Yet the importance of this question of light may be gathered from the fact that in 1900 Berlin counted 24,000 so-called "cellar lodgings," so that 5 per cent. of its inhabitants were then lodged in cellars. There is nothing to show that the percentage is much lower in 1905.

AN INDUSTRIAL REVIEW OF NEW SOUTH WALES.

Among the varied information contained in the various statistical returns of the self-governing colonies few are of greater value than those figures which deal with the internal wealth of a country and the employment—agricultural or manufacturing—of its population. The Government of New South Wales in its Statistical Register for 1903* is no exception to the rule followed in certain of the colonies, but not in the Mother Country, of collecting information as to wages paid in factories or mining industries, and publishing these together with returns of the wages paid, and value of output.

* Published by William Applegate Gullick, Sydney, N.S.W. 1905. Price 5s.

Primarily, of course, New South Wales is a food-producing country, and first place must, therefore, be given to Part IV. of the Register to *Agricultural matters*. In agricultural pursuits 65,213 males and 5,948 females find employment. The preparation of dairy produce provides occupation for 15,208 males and 12,331 females. Pastoral pursuits engage a population of 26,051 persons, making a gross total of 124,751 persons engaged in work of a food-producing character. The value of the principal crops in 1904 amounted to £8,358,924, of which nearly one-half or £3,974,840 represents the value of the wheat grown. Second place is taken by hay of a value of £2,121,934, maize coming third, with crops to the value of £712,160. The value of implements and machinery in use on farms during the year ending March 31st, 1904, was £2,368,072 of farming machinery, £300,107 of dairying machinery, while £710,885 is returned as the value of machinery and implements (the latter sometimes agricultural) on pastoral holdings. As regards live stock, there were 458,014 horses, 1,880,578 horned cattle, and 26,656,501 sheep. Compared with 1901, there is an all-round fall in numbers due to the severe recent drought. The number of horses was then 486,716, of horned cattle, 2,047,454, while the number of sheep were 41,857,099. The drought period was a time of heavy wool and meat exports, the net exports of wool in 1901-02 being 759,536 bales, as against 508,990 bales in 1903-04; the weight and value of the frozen meat exported fell from 513,993 cwt., valued at £585,691, in 1901, to 146,226, valued at £206,160, in 1903. The quantity of butter made in 1903 amounted to 38,727,107 lbs., a quantity only once exceeded. Cheese was made weighing 4,748,176 lbs.—the largest quantity for nine years. The weight of bacon and ham was much less, being 7,864,771 lbs., as against about 9,000,000 lbs. and 11,000,000 lbs. in the two preceding years. Even the total production of milk is enumerated, the yield being about 130 million gallons. Of this about 10 per cent., or 12½ million gallons, was used directly on the farms for butter making; about 2 per cent. was used similarly for cheese making. About 75 per cent. was separated or sent to creameries or factories, the balance being used on the farm or sold for other purposes.

Apart from the population engaged in purely farming pursuits, factories for dealing with the farm produce and farm factories which have separate staffs afford employment for a total population of 28,659 persons. The value of the machinery and plant used for this purpose amounted to £516,155.

Mining.—In any consideration of the mineral wealth of New South Wales first place must be given to gold. The number of persons employed was 11,247, of whom 391 were Chinese engaged in alluvial mining. The value of the plant in operation at the mines was £953,970, the quantity of gold produced being 295,778 ounces, valued at £1,080,029. However, in regard to the value of the output, first place as regards value is taken by coal, of which

6,354,846 tons were mined, and were valued at £2,319,660. The value of the plant and machinery used in coal mining is returned as £1,770,312. Next in importance comes silver (lead and ore), of which 349,064 were produced, these being valued at £1,387,648. The total value of the minerals produced was 5,912,671, being a nett gain of £834,583 over the value in 1902. The production of tin and also of copper was in excess of that during any preceding year, the value of the tin produced by 2,502 miners being £155,723, while 1,816 persons engaged in copper mines produced copper and regulus to the value of £446,286.

Manufactories and Works.—In all 65,633 hands (of whom 52,453 are male, and 13,180 female) are employed in 3,476 establishments. The aggregate capital value represented by the machinery and plant is estimated at £7,009,806. The total sum paid in wages in 1903 amounted to £4,839,557. The industries are grouped under nineteen main headings, these headings being subdivided, and detailed information given in each case..

External Commerce.—The imports during 1903 amounted to a gross total of £26,770,169, of which £12,792,252 was composed of trade with other colonies forming the Australian Commonwealth, £6,651,820 with the United Kingdom, as £1,875,653 (which includes £1,001,300 from New Zealand) from the rest of the Empire. The total from foreign countries amounted to £5,450,464, to which the United States of America contributed £2,779,590, Germany £1,828,105, and France £1,733,593. A total Customs revenue of £2,9c2,687 was collected on these articles. The total value of the exports in 1903 was slightly larger than the imports, being £26,738,111. The exports are divided into three main classes—(1) that of New South Wales produce, (2) re-exports of other Commonwealth produce, and (3) re-exports or other produce. Broadly speaking, near £7,900,000 sterling was the value of the total exports to all Australian colonies; of this about £6,010,000 was locally produced. To the United Kingdom the total exports amounted to £7,560,000, of which £5,866,000 was produced locally. Other British possessions received £3,306,379, of which £1,106,610 was produced in New South Wales. The total sum of the exports and re-exports to countries within the Empire amounted to £18,743,036. The total sum of exports and re-exports to other countries only amounted to £7,995,075, of which the United States took £1,928,299, Germany £1,947,375, France £1,866,487, and Brazil £1,025,348.

BRITISH TRADE IN RUSSIA.

Mr. Consul Grove's Report on the trade of Moscow in 1904 (No. 3441, Annual Series), shows that the United Kingdom is losing ground in its business relations with Russia. Take mill and other machinery excepting agricultural. From 1901 till 1903, the ratio—roughly 1 to 2½ of the import—from the United Kingdom as compared with that from Germany was approximately the same, but in 1904, whilst the import from the United Kingdom decreased by some 900,000 roubles, that from Germany increased by 1,400,000. The same results are seen in other parts. In 1901 the value of the import of iron and steel goods from the United Kingdom was 1,491,000 roubles, as against 5,230,000 roubles from Germany, their respective figures for 1904 being 1,138,000 and 5,021,000. So with wire and wire goods. The imports from the United Kingdom in 1901 were valued at 740,000 roubles, from Germany 3,095,000; in 1904 the respective figures were 653,000 and 3,231,000. Now that the Russian Government has permitted the establishment and official recognition of *bureaux de renseignements* as to the status, &c., of Russian firms, the complaint of British commercial travellers that they can find out nothing as to the status of firms should shortly be a thing of the past. From her geographical position Germany is naturally greatly interested in the Russian market, but Mr. Consul Grove says that "there are very many Russians who would sooner deal with the British manufacturer if they were sure of obtaining equal inducements to those which the German offers, such as long credit, special consideration of local taste, quotations in Russian weights and measures, coinage and language—whereby is undoubtedly facilitated the transaction of business." Against this Mr. Grove says he can show hundreds of British catalogues sent to him annually in English, "with the national, and to the Russian, often incomprehensible, weights, measures, and coinage; these are often accompanied with a request to make the contents known. If it proves impossible to prepare catalogues in Russian—though several British firms do so now—catalogues in German are well understood."

The difference in the class of machinery required in Russia, as compared with that used in the United Kingdom, should be borne in mind. The small and weak pony in Russia cannot draw a heavy plough. The Russian and Siberian requirements in many ways resemble those of Canada. Taking into consideration the peasant's general ignorance of machinery, and the fact that in all probabilty the nearest place where repairs could be effected would be at a considerable distance, Mr. Consul Grove makes the following suggestions—(1) Simplicity of construction; (2) lightness; (3) depôts where all sorts of machinery can be shown, and their construction, &c., explained in the local dialect to would-be purchasers; (4) interchangeable parts and standardisation of machinery; (5) accuracy of manufacture; (6) simplicity of arrangement; (7) cheapness and easy terms of payment; (8) careful packing.

The employment of electricity is rapidly increasing in Russia, and Germany still has the lion's share of the market. The installation of electric lighting in towns, and the conversion of tramways systems to electric traction, &c., is taking place in various towns,

and everywhere it is being done by Germans. The number of motor cars and bicycles is steadily increasing and seems likely to continue to do so, but Mr. Grove says that the only makers he has seen are French, a few Germans, and one or two so-called Russians, but no British. Typewriters again are now largely used and are to be seen in most offices in Moscow, but the import from the United Kingdom is quite nominal. Mr. Grove has "never been able to hear of a single machine of British manufacfacture." Ceylon and Indian teas used to be in considerable demand but there was a great shrinkage in 1903 and 1904. The war naturally interfered with the import *viâ* the Siberian railway, and so tea had mainly to enter by the European ports which may account for the smaller quantity imported, but the drop is remarkable. In 1901 the tea imported by Russia *viâ* the United Kingdom was valued at 7,250,000 roubles, in 1904 at only 3,330,000. There are many difficulties in the way of trade between the United Kingdom and Russia, but it is not easy to avoid the conclusion that this trade would be much larger than it is if British traders were more alive to the possibilities of the markets, and showed greater readiness to meet them.

AUTOMOBILE REGULATIONS IN GERMANY.

Regulations governing the use of automobiles in Germany are made by the police, and are always subject to change by simple order. All rules are strictly enforced. On arrival in the country the owner of a machine must go to police headquarters, give his name, age, place of birth, &c., and make formal application for a police number. No action can be taken until after twenty-four hours have elapsed, when if no objection is taken, a sealed letter will be given to the applicant to be delivered to an official appointed by the police, in most cases an automobile manufacturer or agent, who will fix a time to present the machine for examination. After the examination, a sealed letter is given by the examiner to the owner to take to the police headquarters. If all regulations are complied with, and the examiner s decision is satisfactory, after twenty-four hours, a police number, a foot square and made of tin, with number, &c. painted on it, will be brought to the owner of the machine, with a charge of one shilling and sixpence. The sign must be fastened to the rear of the car, and a lamp must be so adjusted as to throw a light upon the number. The following are a few points in the police regulations that are specially noted by the examiner. The car must have two separate and hanging brakes, each brake must be capable of bringing the machine to a standstill, while at a ten mile pace, within twenty-six feet, and the machine must be capable of being turned in a street thirty-three feet wide; it must emit no smoke or smell; the exhaust must not be in evidence in the streets; it must make no unnecessary noise, and it must be a safe and properly constructed machine. The lamps must be of clear glass, and throw a light sixty-five feet in the darkest night. The steering gear, brakes, and horn, must be so placed that the driver will not mistake them in the dark. A plate, with name of the machine, where made, number of horse-power and weight, must be in a prominent position, and the machine must not appear in the streets or on the roads without a number. No one under the age of eighteen years is permitted to drive an automobile. Police printed licenses on heavy linen paper are given free of charge. and must always accompany the automobile for police inspection. The license is always subject to withdrawal. The Customs duty upon a machine as a whole, landed in Germany, is about 4s. 2d. for one hundred pounds weight; lamps and detachable fittings are subject to an addititional duty. The duty on four rubber tyres is approximately 8s. 4d. Customs duties can be paid, subject to return, when the machine leaves German soil within one year, and the Customs seal is not broken, or off the machine. The American Consul at Aix-la-Chapelle, says that an American machine was recently refused a license in his district because all the above regulations, which, as before observed, are strictly enforced, were not complied with.

GUM ARABIC FROM THE SUDAN.

The trade in gum arabic from the Sudan shows an enormous increase during the last few months, while the price is very low. During the insurrection in the Sudan and while its markets were closed, gum was unobtainable from that region, but in the wake of conquest it began to be shipped again in large quantities from Kordofan, and the high price that had been obtained soon dropped. There were exported from Egypt 21,790,000 pounds in 1902 and 18,939,747 pounds in 1903. All Sudanese products are under a particular disadvantage from the high freight charges in the Nile Valley. Gum is gathered in the forests of the Sudan and is brought to Omdurman, opposite Khartoum, and is there packed, weighed, and forwarded to Cairo or to one of the seaports. There are, at present, three grades of gum recognised by the Sudan government. The first is the "hashab genaine gedaref," the second is the "gezira," and the third the "talh." The first quality is soft and white in colour, and is valued in Europe at 10 or 12 per cent. more than the second grade, which is hard and reddish in colour. The gum of this second quality is packed in parcels of from 370 to 385 pounds and is shipped in double sacks. The first grade, which is bought chiefly by chemists and druggists is, however, packed in wooden cases of 100 pounds each. The trade in Egypt is chiefly in the hands of a few merchants of Cairo or Alexandra.

HOME INDUSTRIES.

Fruit Growers and Railway Companies.—The Chairman of the Great Eastern Railway, in his statement at the General Meeting, referred to the carriage of fruit, and complained that growers are "too fond of adhering to old methods." The Departmental Committee of the Board of Agriculture, to whose report reference was recently made in the *Journal*, found that "the shortcomings of the British growers in not giving sufficient attention to the subject of grading and packing," have much to do with their failure to compete successfully with the foreigner. But the shortcomings are not all with the growers, who have the following complaints against the railway companies:—(1) Exorbitant rates; (2) preferential rates against the home grower; (3) preferential rates to one place over another in Great Britain, unfair incidence of charges and classification; (4) unpunctual deliveries; (5) bad handling; (6) pilfering; (7) inadequate service in many places, and unsuitable vehicles provided, especially on goods trains; (8) delays and losses in connection with empties; (9) difficulty in getting the companies to pay claims for damage or loss. And many of these complaints are, in the opinion of the committee, well founded.

Boxes v. Baskets.—The introduction of boxes for the carriage of fruit instead of baskets is recommended by railway companies. Boxes enable the fruit to be delivered to the market in the same state in which it is delivered to the company, for no pressure can affect a box, and any number of boxes piled one upon another can be conveniently packed in goods waggons in a way that cannot be done in the case of baskets. It may be expected, therefore, that boxes will soon be generally substituted for baskets, but much more remains to be done before fruit is carried and delivered as promptly, cheaply, and carefully as it must be if the home fruit industry is to have fair play.

Pedigree Stock and the Meat Trade.—For many years past there has been a large demand in the Argentine Republic for British pedigree stock, and the cessation or diminution of the demand has been expected by those who have an imperfect appreciation of the possibilities and needs of the Republic. The steady improvement in the quality of the meat exported, and the rapid growth of the meat trade, testify to the wisdom of the generous purchases of pedigree stock by Argentine breeders, and it almost all comes from the United Kingdom. The importation in 1904 was about double that in 1903, and it may be interesting to give particulars of it. The cattle imported were 1,124 shorthorns, 20 Herefords, 26 polled Angus, 14 red polled, and 7 Jerseys; also 2 various. The sheep imported were 2,559 Lincolns, 92 Rambouillet, 145 Hampshires, 232 Shropshires, 19 Oxfords, 54 Romney Marsh, 80 Leicesters, and 83 various. The horses imported were 30 racehorses, 45 Clydesdales, 22 Percherons, 5 Normans, 42 hackneys, 9 shires, 13 Yorkshires, 1 Suffolk, 2 Shetland ponies, and 2 others. The importation as regards pigs were 431 Berkshires and 61 Yorkshires. By a new regulation the pedigree has to be produced when the stock is placed in quarantine on arrival at Buenos Ayres. All the cattle, sheep, and pigs were imported from the United Kingdom with the exception of the Rambouillet, and of some sheep, mostly Lincolns, from New Zealand and Australia, which are well adapted to the Argentine climate. The horses also came from the United Kingdom for the most part. This year the Republic has taken the lead in the supply of fresh meat to the United Kingdom, the United States falling to second place. The effect of the foreign meat trade on the price of live stock in Argentine is shown by the following figures:—In 1902 cross bred steers were worth from 44 dols. to 48 dols., and cows from 34 dols. to 36 dols.; in 1905 they are worth, the one from 75 dols. to 80 dols., the other from 65 dols. to 75 dols. In the earlier year Lincoln wethers were worth from 5 dols. to 5·80 dols., and ewes from 3·20 dols. to 4·50 dols.; in 1905 the respective prices were 9·50 dols. to 10·80 dols. and 9 dols. to 10 dols.

The Motor Car.—The rapidly increasing use of motor cars is affecting various home industries to an extent as yet only very inadequately appreciated. The motor can do pretty well everything on a farm at a great saving of cost; it is proving of great advantage to railway companies as a feeder; it is supplanting the horse for municipal purposes; horse-drawn barges on the canals will soon be things of the past; the Post Office authorities are using the motor more and more. In many other directions it is revolutionising industrial conditions. For example, first-class sea-side hotels are being prejudicially affected by it. Visitors who used to stay at these hotels, said the Chairman of the Great Eastern Company at the General Meeting of the Company, have taken to "merely running down for the day on their motors." On the other hand the motor should help many inland inns.

The Treatment of Foreign Ships.—The Select Committee on the statutory requirements of foreign ships have reported and, as was anticipated, recommend that regulations as to overloading, unseaworthiness and the like enforced upon British ships shall be extended to foreign ships in ports of the United Kingdom. A foreign ship overloaded with cargo taken at a British port may be detained, but there is no other penalty provided, and no requirement as to marking. The Committee suggest that the Government should endeavour to arrange for the adoption of uniform rules of loading by the Governments of the principal maritime countries, and that power be given to the Government to apply by Order in Council in ports of the United Kingdom, the British rules as to load-line to the

merchant ships of any country not complying with rules as to loading which are not substantially equivalent to those in force in the United Kingdom. The Committee also recommend that Section 459 of the Merchant Shipping Act, 1894, should in future be applied to foreign as well as British ships. A British ship unfit for sea by reason of the defective condition of the hull, equipments, or machinery may be detained, and it is proposed to treat foreign ships in ports of the United Kingdom similarly.

The Watch Trade.—Probably no home industry of the minor sort has in recent years suffered more from foreign competition than the watch trade. The demand for highly finished and costly watches is no longer considerable. There will always be a few buyers of these watches, persons of means, to whom cost is not a primary consideration, and a few others ready to make some sacrifice in the purchase of an instrument they hope to keep as a life-long companion. But the general demand is for cheap watches, and largely for very cheap ones. Here the home maker cannot compete with his foreign rival, more especially the Swiss and American. The latter disposes of his surplus stock in this country at a price little or nothing above cost. By keeping his machinery fully employed he produces at a minimum cost, and he gets rid of, say, 80 per cent. of his output in his own country at a price that leaves him a good profit. The odd 20 per cent. it pays him indirectly to sell here at a price which may be said, roughly, to be 10 per cent. lower than the British maker can turn out the same article. Much of the watch trade done by Americans in the United Kingdom is in "movements," and the price accepted is so low that it has led to an ingenious device for checkmating American enterprise in this particular direction. American "movements" have been bought up in large numbers, and sent back to America for re-sale. As there is no duty upon the re-importation of American manufactures, and the cost of the transport of these particular goods is insignificant, a substantial profit has been made on the re-sales. So serious has been the effect that American watch firms located in this country now require a guarantee from wholesale buyers that they will not re-sell to persons intending to send back the "improvements" to America. The largest watchmakers in the United Kingdom are the Lancashire Watch Company, Limited, with headquarters at Prescot. The Company was formed by the late Lord Derby and other Lancashire gentlemen to manufacture complete watches on a large scale where all branches could be centralised, and machinery employed to the fullest extent. It does not cater for the very cheap trade.

The Letchworth Exhibition.—The cheap cottage exhibition at Letchworth is now open, and will be for the rest of the month. Its promoters claim that it demonstrates that cottages adequate to the wants of a labourer's family of the normal character can, under ordinary rural conditions, be erected for £150. And, taken literally, this statement is correct. The actual cost of materials and construction is not more than £150. But it has to be remembered that this sum does not include any fee for design; the building material must be obtained cheaply near the site; there must be no restrictive by-laws. Nor does the £150 cover any profit for the builder, or the cost of the land. What the exhibition shows is that a landowner anxious to house his villagers properly, well placed for materials and labour, and free of restrictive bye-laws, can put up good cottages for £150, which will enable him to allow villagers to rent them at a price within their means, and sufficient to return 4 per cent. upon the capital invested. (See *ante*, p. 939).

Carpet Designing.—British carpet manufacturers have their own causes of complaint in the matter of foreign competition. One of them relates to designs. Many of the large firms have a designing department, costing perhaps £2,000 or £3,000 a year, whose business it is to design new patterns for carpets. As soon as these patterns are delivered German agents go round to the retail shops and buy a yard or two of the new pattern to imitate and copy it on cheaper material. In this way they are able to sell what looks to the uneducated eye a pattern carpet similar to the one from which it is imitated at a price much below the cost of the English article. The German is within his legal right, and, provided he exercises a certain prudence in imitation, it is not easy to see how British firms can be protected from this particular form of unfair competition. It is not, of course, suggested that carpet designing in Germany is not common, or that in comparatively recent years there has not been considerable improvement in the manufacture of German carpets.

Electrical Supply.—As having some bearing upon the battle still raging between the existing electrical companies and the Administrative County of London and District Power Company, it may be noted that the Borough Council of Stepney, which has the most economical electrical undertaking in London, has entered into an agreement with the company for the purchase of a bulk supply, as have the local authorities of Bexley and Barking, while the Corporation of Croydon, which is the largest and one of the most successful electrical undertakings in the south of England, is supporting the Bill promoted by the company.

CORRESPONDENCE.

COAL IN INDIA.

I have just received (at Kargil in Baltistan) the Society of Arts *Journal*, dated 9th June, 1905. It contains a very short note, "Coal in India," which is a bundle of mistakes from beginning to end, and is

written by one altogether ignorant of Indian geography.

1. Coal has not been found in the vicinity of Srinagar. The coal-field referred to in the Geological Survey of India for 1904 is in the Jammu State.

2. The "course" of the railway will not depend upon "the position of the coal in the Jammu hills."

3. The coal has no "tendency to coke," whatever the writer may mean by the expression.

4. The coal seams near Namma may contain a considerable proportion of moisture, most coal does, but that would not make their value small. From the context one might suppose Namma had something to do with Jammu or Srinagar, instead of being the name of an affluent of the Myetrye (Namtu) that falls into that river near the capital of Hsipaw, one of the Northern Shan States.

I am led to writing the foregoing from the general accuracy which characterises the extracts in your *Journal* that refer to Indian affairs. I have not seen the geological report for 1904 yet.

C. M. P. Wright, M.I.M.M.

Srinagar, Kashmir.
July 5th, 1905.

[The note in question was based upon an article in a Calcutta weekly paper, before the Report of the Geological Survey of India had been received in England. The last paragraph, referring to coal seams near Namma, was not intended to indicate any connection with Jammu or Srinagar, but was added as coming under the heading of the article, "Coal in India.".—Ed.]

BRITISH TRADE WITH ROUMANIA.

Referring to the remarks made in the last issue of the *Journal* regarding the possibilities of extending British trade in Roumania (see *ante* p. 938), I should like to add that during my last visit to that country, I noticed a growing desire on the part of several Roumanian firms to increase their commercial relations with this country, but they complained of the indifference of British manufacturers or merchants to conform to the prevailing trading customs, and that they do not send enough travellers, or care to appoint local agents to push their goods.

In view of the improved legislation regarding the exploitation of forests, mines, and with particular reference to the development of the petroleum oil fields, and the encouragement given by the Government for the establishment of industrial concerns, the erection of light railways for private use, &c., there ought to be an inducement for *bonâ fide* investors and contractors to visit that country and investigate matters for themselves on the spot, and keep aside the unscrupulous speculators, of which there are a large number to be found. It must be pointed out that a great many of the past failures of doing good business in Roumania are traceable to such bad connections on both sides, and to the lack of the characteristic soundness of English business principles, and insufficient knowledge of the requirements of the people and country.

In a recent conversation which I had with His Excellency the Roumanian Minister here, I ventured to suggest that it would be advisable to have translated into English the new laws bearing on the subject of exploitation of mines, forests, erection of railways, &c., and to have the same widely circulated among interested parties. The Roumanians have learned to know that only with plenty of capital and with good organisation can success be attained.

L. Gaster.

32, Victoria-street, Westminster, London, S.W.
1st August, 1905.

GENERAL NOTES.

The Suez Canal.—Some interesting particulars are given as to the growth and present dimensions of the Suez Canal, by Mr. Consul Cameron, in his report on the trade and commerce of Port Said (No. 3448, Annual Series) just published. The navigable dimensions of the canal in 1905 are practically double what they were twenty years ago, the superficies of the vertical profile having been increased from about 320 to 580 square metres in the ordinary channel, and to 740 square metres in the numerous gares, or crossing places, the dredging being so carried out as to exceed the limits originally agreed upon. The following details are taken from a memorandum furnished by M. Perrier, the chief engineer of the company, to Mr. Consul Cameron. From 1869 to 1875 the canal retained its depth of 26 feet 3 inches, and its bottom width of 72 feet throughout its length of 99 miles. The crossing places were about 10 kilometres apart, each being about 1,100 yards long. From 1875 to 1884 the first improvements were made in straightening and widening the curves. During 1887 and 1888 the canal was widened half a metre, the bottom width being reduced (on the same slopes) to 18 metres. This extra depth allowed the transit of vessels with a draught up to 25 feet 7 inches. From 1888 to 1895 the bottom width was increased to 108 feet, and the curves were also improved. The result was the diminution in time of transit which had already been shortened by the use of the electric light since 1887, and ships could now pass at any point of the straight reaches of the canal, instead of only at the crossing places. From 1898 to 1904, owing to the increased dimensions of ships, larger passing stations were commenced, some twenty in number, at intervals of 3 miles, each passing station having an effective length of 820 yards with approaches of 328 yards at either end. At each the bottom width of the canal is 50 yards, the width at the water level over 100 yards, while the depth of the passing station itself is 9½ metres. At the same

time the depth of 8½ metres in the channel had been increased to 29½ feet, so that on January 1, 1902, a draught of 26 feet 3 inches was allowed instead of 25 feet 7 inches. The work of deepening the channel is steadily proceeding with the intention of arriving at a uniform depth of 31 feet. From kilometre 61, near El-Ferdan, as far as Suez, the bottom width is to be increased from 102 to 128 feet. The curves are also being improved, and a large crossing-place is being constructed in the small Bitter Lake. Taking the canal as a whole, it may be said that its width on the water level in the northern half is from 100 to 120 yards, and in the southern half from 80 to 100 yards. Lastly, the widening of the channel at Port Tewfik will enable battleships and large cruisers to coal rapidly alongside the buoys, instead of having to coal slowly in the roads.

THE PORT OF GENOA.—The work of enlarging the port of Genoa is to be begun this year. The cost of the enlargement is estimated at £2,000,000. The work is one of the very greatest importance to Genoa, and, indeed, to Italy in general, especially now that the Simplon Tunnel is completed. Exportation up to the present has taken little part in the traffic of Genoa, but it is hoped that it will become more important, and efforts are to be made to make Genoa a great centre for international merchandise, thus insuring vessels the possibility of finding return cargoes and merchants the power of sending their goods to all parts of the world. It is recognised that the Simplon Tunnel and other projected lines of railway between Switzerland and France will draw much traffic to Marseilles, and that the competition of the northern ports of Germany, the Netherlands, and Belgium will always remain very quiet. But if all the contemplated improvements in the port and the railway are carried out, says Mr. Consul-General Keene in his report on the trade of Genoa (No. 3446, Annual Series)—and it is essential for the vitality of the port that every facility should be given by the Italian railway authorities—encouragement would be given to merchandise being brought to Genoa from other countries for shipment to any part of the world. Supposing these hopes are reached, it is calculated that in twenty years the port of Genoa might attain a movement of 10,000,000 tons, which is nearly double the present annual movement, but this would necessitate a corresponding movement on the railways of 2,000 goods wagons per day instead of the 1,200 as at present.

BRITISH TRADE AND DELAGOA BAY.—Figures given by Major Baldwin, in his report on the trade of Lourenço Marques for 1904, show how much British trade with that port is suffering from the monopoly of the German East Africa line of steamers in the carrying trade between the competing European ports and those of the East Coast of Africa. The steamers of the Austrian Lloyd Company provide a monthly service, by the East Coast, between Trieste and Durban, and the British India Company's steamers have also a monthly service along the same coast, either to Bombay or in connection, by transhipment, with their European service from India, but for all practical purposes the German line has a monopoly of the direct trade with the great manufacturing and distributing centres of the continent. The effect upon shipping and the carrying trade is very marked. Whilst the total British tonnage entering the port decreased from 876,130, in 1903, to 854,027 in 1904, German tonnage in the same year increased from 216,194 to 267,832. Taking a wider view, it will be found that whilst in 1898 a total of 305 British ships entered the harbour, and only 50 German, in 1904 the British entries had decreased to 269 and the German increased to 71. No doubt it is the heavy subsidy which gives the German line the monopoly, but this monopoly is a great aid to German trade. "The existence of a direct, regular, and efficient line of national steamers," observes the Consul-General, "even although freight be neglected in agreement with other and indirectly competing lines, must tend to throw trade into the hands of the manufacturers of the country to which the line belongs, and those ports it is its principal business to serve."

DAMASCUS.—Electric lighting and tramway schemes seem incongruous when associated with Damascus notwithstanding its population of 230,000 or more, but according to Mr. Consul Richards (No. 3437, Annual Series), whose report is dated as late as June 1st last, a scheme of the kind is now under serious consideration with a view to its realisation. The possibilities of the enterprise have been studied on the spot by a competent Belgian engineer, who has sent in his report to Constantinople, and it is said to be distinctly favourable. Another public works scheme which has been under consideration during the past year, and is thought to be feasible, is a project for supplying Damascus with a good and abundant supply of drinking water from the Ain Fiji source of the Baroda River.

REGISTRATION OF TRADE-MARKS.—In his report on the finances and trade of the Argentine Republic (No. 3434, Annual Series), Mr. Harford, First Secretary to His Majesty's Legation at Buenos Ayres, points out that it is very important for foreign trade-marks on important articles to be promptly registered in the Argentine Republic, as cases have occurred where the trade-mark of a well-known firm has been adopted and registered by an unscrupulous person, and the real owner prosecuted for using it. The latter may even be cast in damages. The use of a showy and distinctive mark, combined with lavish advertising, will, says Mr. Harford, do more than quality alone to ensure a large sale in the Republic. It is also important to note that a contract signed in the United Kingdom cannot be enforced in Argentine unless it has been visé at an Argentine Consulate in the United Kingdom.

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FRIDAY, AUGUST 11, 1905.

NOTICES.

EXAMINATIONS.

The following is the Time Table for 1906:—

	Monday, April 2. (7—10 p.m.)	Tuesday, April 3. (7—10 p.m.)	Wednesday, April 4. (7—10 p.m.)	Thursday, April 5. (7—10 p.m.)	Friday, April 6. (7—10 p.m.)
Advanced Stage.	Book-keeping. English. Economics. Danish and Norwegian.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Accounting and Banking. Shorthand (150 and 120 words per minute), (7.15 to 10 p.m.)	Portuguese. Précis-writing. Russian. Swedish. Chinese. Japanese. Hindustani.
Intermediate Stage.	Typewriting (7.30 to 10 p.m.). French. Danish and Norwegian. Commercial History and Geography.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Swedish. Shorthand (100 and 80 words per minute), (7.15 to 10 p.m.).
Elementary Stage.	Handwriting and Correspondence. French.	German. Italian. Typewriting (7.30 to 10 p.m.).	Book-keeping Spanish.	Shorthand (50 words per minute), (7.15 to 10 p.m.).	Commercial Geography. Arithmetic.
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

The last day for receiving entries is February 28th.

The special subject for Commercial History and Geography is:—Eastern Asia, including the whole of the Chinese Empire.

SECTIONAL COMMITTEES.

COLONIAL SECTION COMMITTEE.

The following is the list of the Colonial Section Committee, as appointed by the Council:—

Sir Owen Roberts, M.A, D.C.L., F.S.A. (Chairman of the Council).
Sir Westby B. Perceval, K.C.M.G. (Chairman of the Committee).
Earl of Aberdeen, G.C.M.G.
Hon. Sir William Arbuckle, Agent-General for Natal.
Lord Belhaven and Stenton.
Sir James Blyth, Bart.
Lord Brassey, K.C.B.
Byron Brenan, C.M.G.
Sir Thomas Fowell Buxton, Bart., G.C.M.G.
Hon. Sir John A. Cockburn, K.C.M.G.
T. A. Coghlan, I.S.O., F.S.S., Agent-General for New South Wales.
H. Bertram Cox, C.B.
Edward Dent.
Rt. Hon. Sir Charles Wentworth Dilke, Bart., M.P.
Hon. Alfred Dobson, Agent-General for Tasmania.
Hon. Sir Charles W. Fremantle, K.C.B.
Hon. Sir Thomas E. Fuller, K.C.M.G.
Sir Robert Giffen, K.C.B., LL.D., F.R.S.
Right Hon. Sir George Goldie, K.C.M.G., D.C.L., LL D.
Robert Kaye Gray.
W. L. Griffith.
Sir John J. Grinlinton.
Sir Charles Augustus Hartley, K.C.M.G., M.Inst.C.E.
Sir Clement Lloyd Hill, K C.M.G., C.B.

Hon. Walter Hartwell James, K.C., Agent-General for Western Australia.
Hon. J. G. Jenkins, Agent-General for South Australia.
Sir Alfred L. Jones, K.C.M.G.
Sir Charles Malcolm Kennedy, K.C.M.G., C.B.
Sir Nevile Lubbock, K.C.M.G., Chairman of the West India Committee.
Charles Prestwood Lucas, C.B.
Sir Montagu F. Ommanney, K.C.M.G.
Sir E. Montague Nelson, K.C.M.G.
Sir Gilbert Parker, M.P.
Hon. W. Pember Reeves, High Commissioner for New Zealand.
Viscount Ridley.
Right Hon. Sir Joseph West Ridgeway, G.C.M.G., K.C.B., K.C.S.I.
Alexander Siemens.
Sir John Smalman Smith, M.A.
Earl of Stamford.
Lord Strathcona and Mount Royal, G.C.M.G., LL.D., High Commissioner for the Dominion of Canada.
Sir Thomas Sutherland, G.C.M.G.
Hon. J. W. Taverner, Agent-General for Victoria.
Carmichael Thomas.
Hon. Sir Horace Tozer, K.C.M.G., Agent General for Queensland.
Sir Charles Rivers Wilson, G.C.M.G., C.B.
Sir John Wolfe-Barry, K.C.B., F.R.S.
Sir Frederick Young, K.C.M.G.
S. Digby (Secretary).

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

SOME ASPECTS OF ANCIENT AND MODERN EMBROIDERY.

By Alan S. Cole, C.B.

Lecture I.—Delivered May 1st, 1905.

The origin of our word embroidery is relatively modern, although the art of embroidery is of great antiquity. There seems to be no one corresponding word in Latin or Greek which is so comprehensive in possible meaning as that of our word embroidery. According to various authorities, it is derived from the French word "broder," which in its turn throws back to some Celtic source, such as the Breton word "brouda," to pierce, the Welsh word "brodio," to embroider, and the Gaelic "brod," a goad. Although we can use our word embroider in different senses, when we use it to indicate ornamentation done with threads as an enrichment to some textile or flexible material, we have of course in our mind work of stitchery done with a needle. But I hope to show you that embroidery may be equally well descriptive of thread ornamentation done in a manner less like that of needlework than that of shuttle weaving. In this case, the thread ornamentation plays a part in the actual construction of a textile. In the course of my two lectures on "Aspects of Ancient and Modern Embroidery"—and you will therefore understand that I am not attempting to give a comprehensive historical sketch of embroidery—I shall, amongst other matters, try and make clear by illustrations the characteristic feature (1) of embroidery as a method to construct or to complete the texture of a material partly woven in a loom, and (2) of embroidery as the needle-stitched embellishment of an otherwise complete woven material. In the one case, I think you will see that the embroidery is a necessary part of the woven material decorated with it, whilst in the other it is an addition, and therefore not essential to the construction of the material upon which it appears. Both, however, have a characteristic in common, which justifies each being called embroidery in a popular sense, as each is an expression in threads of ornamental intention. Moreover, each involves the use of an implement, which, however different as occasion required, was called by the Romans, at least, by the same name of acus.

Acus was a generic name, in fact, for a pointed implement. It meant equally such various things as the tongue of a buckle, a hairpin, a bone or wooden pointed instrument, large and small, as well as a needle with or without an eye to it, and, as compared with modern steel needles, a good deal bigger and coarser. In one shape the acus resembled a primitive shuttle or bobbin, in another a skewer. At one time we read of it as a needle, indispensable to the sarcinatrix, or mender of clothes; at another it is the pin with which the ornatrix, or slave who looked after the hairdressing and adornment of her mistress, fastened the loops and plaits of her hair together and fixed sundry ornaments to her costume. In another shape the acus was the particular instrument of the plumarius, who was a worker of ornament in coloured threads, and, so far as I can judge, usually adopted a sort of weaving or darning method for his work. Needle-stitched embroidery may have been done by another set of workpeople. It is, however, to these two distinctly different methods of ornamental thread work that I wish to direct some attention: and we shall see how at one period the two methods seem to have been concurrent in practice and how at other times one or other seems to have been the more ordinary method of embroidery. In whichever of its shapes we regard the instrument required for each method, whether

as a species of weaving or darning needle or as one particularly adapted for stitching, it is in both aspects the stiff-pointed continuation of the flexible thread in use. Unfettered by such contrivances as determine the possible movements of a machine, the needle in embroidery moves according to the taste and ingenuity of the fingers guiding it, and sweeps with perfect freedom along the surface or through the thickness of the stuff. Like pen or pencil it can be made to trace forms of any complexity, and, in two words, it writes and it draws. Used with a variety of coloured threads, its function resembles that of a brush in depicting tones and shades. The Romans frequently spoke of painting with a needle—"acu pingere"—and the craftsman who did such work was called "pictor," or painter.

In those days little, if any, distinction was made between the painter with a brush and the painter with a needle. Each seems to have had an equal standing with the other. Both usually were members of the body of slaves employed by a wealthy family, and we read that the members of such bodies were architects, builders, plasterers, statuaries, sculptors in low relief, decorative wall painters, weavers, embroiderers, gardeners, and the like. In the earlier times of the Roman emperors, the larger number of these slave artists and artificers attached to households were Greeks, whose ancestors for generations previously were, as we know so well, pre-eminently dexterous in all branches of art. Thus, as between Rome and Greece, we have an obvious continuity in the practice of such an art as embroidery, and of this we have several valuable and substantial pieces of evidence, to some of which I shall refer shortly. From Roman times down to the present, proofs of corresponding continuity are more plentiful.

In a previous course of lectures which I gave here ten years ago, I suggested various methods by which embroideries were wrought by Egyptians, Assyrians, Babylonians, and other more or less neighbouring Oriental people who were in frequent intercourse with one another during the two or three thousand years immediately B.C. I do not again review these methods, nor do I propose to touch on that extensive field covered by the embroidery of the Japanese, Chinese, Persians and Indians. In regard, however, to ancient Egyptian embroidery, a discovery made quite lately seems to have a very special interest for us in proving the prolonged use of that one method of embroidery which I have mentioned as a weaving or darning method. We can trace its employment in Greece and in Rome. When one finds at one end of a period the employment of a method which is in full practice at the other end of the period, it is, I think, fair to assume that such a method has had a continuous life during the whole period. Without having the material evidence which has now been obtained, I suggested in my lectures on "Egyptian Tapestry Weaving," in 1889, that this weaving or darning embroidery must have been in use at least 600 years B.C. I am therefore glad to find that my suggestion has been more than verified by the recently discovered fragment of the embroidered dress found with a mummy bearing the name of Amenothes the Second, whose date is about 1450 years B.C., or some hundred years before the Exodus. (Fig. 1.)

FIG. 1.

EGYPTIAN WORK OF AMENOTHES II.

Here, now, is this very interesting example, reproduced from the *fac-simile* published of it in an issue, dated 1904, of the "Catalogue Génerale des Antiquités Egyptiennes," by Messrs. Howard Carter and Percy Newberry. It is of linen and wool; the different emblems and devices are of coloured wools, which, being darned in between and over the unwoven linen warp threads, complete the whole texture of the piece. The ornament of the border is composed of alternating

flowers and buds, a version of the very ancient flower and knop pattern. Amongst the symbols we see that of royalty, consisting of two asps, one bearing the head-dress or crown of Upper Egypt and the other that of Lower Egypt—and their two up-turned tails merge into one another over the disc or solar emblem. The illustration does not show with distinctness the threads of the weaving and those of the embroidery, but in a bit of corresponding make, the characteristic of the method — in expressing ornament, at the same time making a fabric—is easily seen on a larger scale. The tapestry wall hangings of the fourteenth century and onwards were made in this manner; and later in my lectures as instances of a revival of the method, I shall show an illustration of one or two small articles, such as pouches, which were made last year in this country. This method, however, which we find to have been common in use for centuries, is not much mentioned in the various books on embroidery as holding an important place in the history of embroidery: it is indeed usually ignored altogether. As a means of embroidering costume and domestic cloths, &c., it is undoubtedly much slower and involves more labour than needle-stitched work. Its practice was compatible with the comparatively less rapid conditions of ancient times, and it is not surprising to find that, with the more extended activities of later times, it died out. Needle-stitched embroidery developed and proved itself to be of readier use and in some respects more telling in its effect than the darning embroidery.

With the Greeks of say the fourth century B.C. this darning embroidery seems to have been as usual a method for ornamenting woven stuffs as the needle-stitched embroidery. It appears to have been an occupation chiefly for women, and I have not come across a mention of Greek men embroiderers, none at least corresponding to that of Roman men embroiderers. In Greece, as for instance at Athens, embroidery was made almost solely for the very wealthy. It was done in their houses, where rooms were reserved for the women, who rarely went outside, living as enclosed a life as that of the cloistered nun of later times. The chief occupation of the Greek women, besides housework and preparing meals, consisted of spinning, weaving, and embroidery. Their work-rooms, without wooden floors or glass windows, gave on to inner courtyards, and, as compared with the ordinary modern English work-room, were no doubt somewhat draughty, and not too well lighted. Still it was in such quarters that the Grecian women lived their lives, and pursued their occupations. As a class, they were treated more or less as children in seclusion, their mothers and nurses were their teachers, and, beyond receiving a smattering of general education, the girls were trained in domestic work only. Time was of little account, so that a slow and regular acquirement of skill led to excellent work in such materials, linen and worsted, as were then available for it. From the indications we have, the patterns from which the weaving and embroidery were done must have been well drawn, and often of an intricate character. In some districts families or groups of women were bound by law to make festival garments for holy images. For instance, every four years upon the recurrence of the Panathenaic festival, a selection of Attic maidens wove and embroidered, for the figure of Athenæ, a peplos ornamented with portraits of celebrated men. Elsewhere, sixteen matrons were required to produce a peplos for the statue of Hera, at Olympia; and again, noble maidens of Argos discharged a similar task for a statue of Artemis, whilst those of Sparta worked a robe for Apollo. Thus, embroidery was not merely a home industry or occupation followed by individuals in respect of their own wants, but an art craft necessary for purposes of public ceremonial.

Of the very few illustrations on Greek vases, &c., of women actually engaged in some sort of embroidery, I have chosen one, which I now throw on to the screen. (Fig. 2.) The seated woman, as we see, is completing work in a small hand-frame. The kind of work is, I think, that of the darning and weaving to which I have referred; here, however, it appears to be in course of making, quite independently of linen. A larger frame would be necessary for linen cloths which were to be ornamented and completed with darning embroidery. A remnant or two of such Grecian work is preserved in the Hermitage, at St. Petersburg, and these I now show. The first displays a border of lotus-like blossoms darned or woven in coloured worsteds in between parts of an ordinary shuttle-woven material.

The next specimen worked in the same method is powdered with ducks. These specimens date from about the fourth century B.C., and so, too, does that shown in the next slide. The work here is of needle-stitched chain-stitch

embroidery of fair yellow-linen thread upon a reddish woollen material. The ornament of this latter piece is a good deal more elaborate than that of the two previous pieces. It is rather difficult to decipher it from the fragments; I have, therefore, made a drawing which I think correctly represents the pattern from which our Grecian embroideress would have worked her cloth or peplos. From these examples, and bearing in mind that the number of dyes was very limited, and that

FIG. 2.

GREEK WOMAN AT WORK.

silks with all their shimmering effects were not obtainable, we may conclude that Grecian embroideries before Christ were, as a rule, rather sombre in tone in comparison with the many-coloured silken embroidery intermixed with gold and silver threads of, say, 1,500 years later. Distinctly Greek in style, with its repeated anthemions, or honeysuckle devices, is this next specimen. It is of darning embroidery, and is the border—or paragauda, as the Romans termed it—to the neck of a tunic. The circumstances under which it was discovered point to its being probably seven or eight centuries later than the previous Grecian embroideries. It is, in fact, Grecian work of a rather late Roman period—say, about the third or fourth century A.D.

Now as regards embroidery in Rome during a period before the Christian era, we find that its condition as a home occupation or industry for women corresponded closely with its condition in Athens. It was followed in the quarters set apart for women in the houses of the richer class. These rooms, called in Greece gunaikonites, were gynecea in Rome: but the gynecea of the Romans were less closely supervised by their Roman mistresses and did not preserve, for so long a period as the Greeks did, their domestic, as distinct from a trade, character. As luxury increased the quarters allotted slaves in a Roman town or country house seems to have become converted into workshops suitably equipped and organised as trade workshops. The exterior rooms about Roman town mansions consisted frequently of shops and trade workrooms, tabernæ as they were called, whilst the owner of the mansion probably had, in the earlier times at least, a first call upon the services of the various artificers employed in the premises surrounding his mansion; later on these artificers and their workrooms served the public. Such development of Roman shops and trade workrooms seems to have been accompanied by the formation of workmen's societies, associations or, as they were called, collegia opificum. Amongst such associations were those of weavers and embroiderers. Their workshops were known as textrinæ, and in the first century A.D. there were several of them in the famous Vicus Tuscus which ran from the Via Sacra past the Basilica Julia. It was indeed a sort of Regent-street, noted not only for the textrinæ, but also for its perfume shops, and for the public processions which usually passed down it. The workshops of the weavers and embroiderers were generally one storey in height, and were evidently better than the underground dwellings of such craftsmen in Germany and parts of Northern Italy, of which Pliny took note, no doubt as being remarkably different from the work-rooms he was accustomed to see in Rome. The interior of a shop for the sale of textiles is given in a Pompeiian wall-painting preserved in Naples, and may quite well serve to represent a similar Roman shop, and to show that the conduct of business in a shop then was practically the same as it is now. I wish I could have found an illustration of weavers and embroiders at work. From descriptions, however, it is certain that the weavers or textores worked as a rule in company with a set of artificers called plumarii. Varro, writing in the first century A.D., particularly distinguishes the trade of the textores or weavers from that of the plumarii or embroiderers, and says that instruction in painting was a necessary part of their training.

The aspect which I have so cursorily given

of the textile craftsmen and women in Rome, corresponded doubtless with that of similar craftsmen in such Roman towns as Alexandria in Egypt and Antioch in Syria. From Alexandria and other Egyptian towns under Roman influence many ornamented textiles were imported by Rome, and a fashion for such things seems to have prevailed for many years, in support of which we now possess a large quantity of specimens taken from burying grounds in parts of Egypt. The greater number of them are embroideries done in the darning method to which I have already called your attention. Several of them are from designs distinctly Roman in style. Prior to the discovery, some twenty-five years ago, of these embroideries, a good deal of discussion took place as to the precise nature of work done by the plumarius. In his "Gallus," Becker comes to the conclusion that the plumarius did not adorn, with needlework, garments already made, but wove ornament in some special manner. As far as this conclusion goes it is sound, but it is now, I think, carried still further by the specimens which we possess of Roman or Egypto-Roman darning or woven embroidery, the technical method of which may be accepted as the special kind of work done by the plumarii. "Opus plumarium" is often mentioned in inventories of the thirteenth century, at which time the completion and adornment of stuffs with inwoven embroideries had been superseded by needle-stitched embroidery. The term "opus plumarium," as used in the thirteenth century, seems to be merely the survival of a term from classic times, and is not descriptive of long and short or feather-stitch needle embroidery. The Roman "opus plumarium" of the first few centuries A.D. seems to me to be exemplified by such specimens as I will now throw on the screen. You will notice that the method of work is the same as that we saw in the Egyptian cloth of Amenothes II., and in one or two examples of Greek work of the fourth century B.C.

Here is a square panel of this Egypto-Roman work (Fig. 3). The group of figures, somewhat rudely rendered, is evidently from a design of Roman origin. Venus is seated, Vulcan is raising his hammer, and Mars is about to draw or has just sheathed his sword. Panels of this description about eight or nine inches square were wrought on to the skirts of tunics.

Similar work was done on cloths, tablecloths, and cnshion covers, as in this slide. Here again the figures and animals are rather rude in rendering, but they are just such as may be seen, somewhat better drawn, in Pompeiian paintings.

Here is a tunic with large sleeves, ornamented with two broad bands of darning embroidery. This type of dress was in ordinary use in Rome during the first few centuries A.D. Many tunics were more elaborately decorated and with narrower bands. Here are a few specimens of such narrower bands, all of darning embroidery, which, with the woven linen about it, completes the fabric. The centre band with vases and baskets in alternation is distinctively Roman in style.

We have not much evidence of needle-

FIG. 3.

EGYPTO-ROMAN SQUARE.—VENUS, VULCAN, MARS.

stitched embroidery at this period, and little more I am afraid than a side light is thrown upon the employment of women in textile arts by such an illustration as the one now shown. It is taken from a painting in a MS. of the fifth century A.D., which is known as the Genesis fragment of the Imperial Library at Vienna. One lady with the child at her knee is spinning or winding thread, and the other one may perhaps be doing some sort of embroidery. At this date rich persons wore costumes plentifully ornamented, and the fashion was censured from the pulpit by Asterius, Bishop of Amasia in Pontus. "Every one," he said, "is eager to clothe himself, his wife and his children with stuffs ornamented with flowers and numberless figures, and to such an extent is this done, that when the wealthy classes show themselves in public, little children gather round them in crowds and point their fingers at them, making merry at their expense. The more religious of the wealthy classes

require artists to supply them with subjects taken from the New Testament." Some idea of this condition of ornate costume may be got from the well-known sixth century mosaic of the Empress Theodora and her ladies at Ravenna. I imagine that the greater quantity of the ornamentation here displayed was of darning embroidery, and little, if any, of needle-stitched embroidery.

The four specimens on this slide are of needle-stitched work, and that on the lower left corner is possibly of sixth or seventh century work from a design which is, for that time, of fairly good standard. It is wrought in silks of brilliant colours, crimson, green, yellow, &c., the forms of the figures and their draperies being outlined in black. The other three bits are obviously worked from poorly drawn designs; all of them, however, are of a Christian religious character. These embroideries were wrought originally on tunics, worn by Romans or Byzantines who died in Egypt, but they none the less serve to illustrate a style of embroidery which was equally familiar with Romans and Byzantines living in their own countries.

I am now about to try and deal, but only in a very general manner, with the conditions that arose and were favourable to a large movement that fostered the arts of designing, religious subjects particularly, and of embroidering them. Zeal in spreading Christian doctrine lies evidently at the root of such movement, which was very largely due in fact to monasteries, convents, abbeys, and the like. These came to be rapidly established throughout Italy, France, and Britain, which I specify because the examples of ninth, tenth, and eleventh century embroidery I have chosen as illustrations, were apparently made in the two last-named countries—France and Britain, whilst the first-named, Italy, is practically the birthplace of that form of the monastic movement of which I think we must take chief notice.

"It is," says Mr. I. W. Bradley, in his useful handbook upon illuminated manuscripts, "a curious and important synchronism that, whilst Justinian was reviving the splendour of Roman arms and political life in the East, St. Benedict was creating the great religious foundation of Monte Cassino, which was to become the preceptrix of the West in religious literature and art. Such was its fame within the lifetime of the founder that most of the existing communities were eager to adopt its rule; and by the eighth century a number of busy offshoots were, not merely continuing, but striving anxiously to increase and disseminate its practical teachings as the basis of the new Christian civilisation." The monastic life had come from Egypt into Italy about the fourth century A.D. It was a life chiefly of fasting, meditation, and prayer, but so frequently had it degenerated into one of idleness, listlessness, and even self-indulgence, that it called into action a reformer in the person of St. Benedict, who appeared on the scene in the sixth century to put matters right. He framed a code of rules by which a monk's time was to be devoted as much to work as to religious exercises. The leading occupations were to be worship, study, and labour. Benedict's code is voluminous and precise, and is probably the most famous of all monastic codes. Amongst its regulations there is one requiring abbots of monasteries to provide each monk with a knife, a pen, a needle, a handkerchief, and tablets, thus enforcing a general provision of those very things which, in the hands of able and enthusiastic monks, would inevitably, it would seem, lead to systematic practice in writing and drawing and needlework, equally for utilitarian or decorative purposes, or for both.

Illuminated manuscripts—some few with authentic details as to how, when, why, and by whom they were produced—have come down to us from the time of St. Benedict, and convince one that a widespread obedience to his rules was long sustained, and was attended with many results of fine writing and illumination. As regards embroidery, the evidence is not so direct; still, it seems to be sufficient for something more secure than plausible inference alone. It was a craft, and as such would come under another part of the Benedictine Code, which prescribed that craftsmen in various callings amongst the brethren were to undertake work with the abbot's permission. When their work was for sale, those brethren entrusted with making the bargains were to deal honestly with purchasers, and to sell rather below than above current prices. The nunnery established also at Monte Cassino by St. Scholastica, Benedict's sister, was carried on under corresponding regulations, and it is reasonable to suppose that, under the favourable conditions of their life, Benedictine nuns would, like other women of the times, have paid particular attention to cultivating the arts of embroidery, weaving, &c., taking for their designs those which neighbouring monks had as a rule the greater skill in making.

From an illuminated, or rather a well illustrated, codex respecting all sorts of things—a mediæval encyclopædia—written by a scholar of great distinction, Rabanus Maurus, in the ninth century, I have taken a page showing the crafts of spinning or winding threads and work of a weaving character pursued in the gynæcea, or women's work-rooms, of his time (Fig. 4). From the character of the frame, and the stretched rank of warp threads, it must be not an ordinary shuttle-weaving loom, but a darning or tapestry-weaving frame, alike, in its essentials, to the tapestry-weaving frames which are pictured with women working at them, in manuscripts of much later date.

FIG. 4.

GYNÆCEUM FROM THE CODEX OF RABANUS MAURUS.

Rabanus Maurus was elected abbot of Fulda in Germany in the ninth century, and compiled his codex, or encyclopædia, in his retirement. His codex is now preserved at Monte Cassino, and, as may be easily supposed, is an historical document of very great interest. It throws light upon the general condition of civilisation and industrial employments, the development of which was due at that time practically to the monasteries and their missionaries. That at Fulda, in the eighth century, was as notable for its high standard of activity as those at Monte Cassino, at Tours, and at York. Historians have told us how intimate the relations between such centres far distant from one another must have been. Some forty years before Rabanus Maurus was abbot at Fulda, Eginhard, the biographer of Charlemagne, had been educated there. His artistic skill was such that he received the name of Bezaleel, who, as we read in Exodus, was the architect and decorator of the Tabernacle or Sanctuary, a man filled with the spirit of God in wisdom, understanding, and all manner of cunning workmanship, including embroidery. Early in life, on account of his great abilities, scholastic and artistic, Eginhard was appointed to the household of Charlemagne, who contracted a close and lifelong friendship with him. Similarly, the Emperor, zealous to promote learning and practice of the arts, enrolled in the circle of his intimate associates and advisers Alcuin, the distinguished scholar and head of the then famous Church School at York. The Emperor had met him casually at Parma, and made his acquaintance, and quickly discovered its great worth. Incidents like these indicate the cosmopolitan and progressive character of the Emperor, and how zealous he was to guide and promote the general social developments of his kingdom.

The boundaries of Charlemagne's kingdom included all modern France and some part of modern Germany, and, scattered over these countries, as well as Britain, were several Benedictine monasteries and convents, working with more or less united enthusiasm for the spread of learning, religion, and the arts. Some naturally excelled in their artistic performances, whether in the direction of writing, illumination, or embroidery, or otherwise. It is easy to see, however, that such an extensive organisation became powerful in its religious and educative influences under the practical interest which Charlemagne manifested in it, and the many branches of its operations. With the help of friends such, amongst others, as Eginhard and Alcuin, he organised a large body of officials, experienced men, both of the laity and clergy, to travel about, inspect, report, and advise upon the various educational, artistic and other enterprises which were being carried out locally by the different bodies concerned with them. These officials were called missi dominici. The instructions issued to them were very detailed and precise, and their advice and inspection must have generally acted as a stimulus to the inmates of the abbeys, monasteries, and schools. It was the custom of many of these establishments to send presents to the Emperor, and inspectors were told to recollect "to order that they who send me horses as presents inscribes their names on each horse, and so with dresses that may be sent us from abbeys."

In connection with this mention of dresses I now refer to a sumptuously embroidered dalmatic, preserved at St. Peter's, in Rome. The tradition is that it was worn by Charlemagne on Christmas Day, 800, the date of his Coronation as Emperor of the Holy Roman Empire. He is then said to have sung the Gospel at High Mass, vested as a Deacon. Some have ascribed this very fine specimen of embroidery to the hands of the Emperor's wife; others have doubted it being work of the ninth century and have urged reasons for regarding it as work of the twelfth century. It seems to me to be far too elaborate in design and technical stitchery to have been done by an amateur embroideress, notwithstanding her exalted position as an Empress, a view also applicable, I think, to the idea that Matilda, wife of William the Conqueror, worked the Bayeux Tapestry. Both of these historically famous needle-stitched embroideries are more probably by embroideresses who were kept pretty closely to their work, doing it under guidance from designs specially drawn by such competent draughtsmen as lived at the respective periods concerned. Now this combination of skill at each period may be confidently looked for at abbeys and monasteries. I will here show two illustrations of the Charlemagne Dalmatic. It is of blue silk, embroidered with gold and silver threads mainly, though picked out here and there with red and black. The event depicted on this side of the vestment is apparently the Ascension. The central figure of Christ is worked in silver, and the figures below are in gold. The smaller figures on the shoulders and short sleeves represent the administration of the Communion. In the central and important composition, Christ is shown as a man with a beard, a type of portraiture more common according to Christian iconography after the tenth century than before it. The other side of the dalmatic gives us a more formal arrangement of figures, with one representing Christ as a youth beardless, seated and as a sovereign, surrounded by angels, and earthly magnates, grouped into a circular arrangement within a roundel. (Fig. 5). In this composition, the central figure of Christ is golden and the surrounding subordinate ones silver, thus reversing the order in which these metal threads were used for the back of the vestment, and indicating the designer's appreciation for the effect of a calculated counter-change of colour. Similarly, his appreciation of the value of contrast is shown in the free and open arrangement of figures on the back, and the circumscribed and closer arrangement of figures on the front. The obvious attention which has been given to æsthetic principles in producing the design, as well as to its epical or story-telling interest, point, as I have said, to the work having issued from some centre, equipped in all respects for constant practice of the decorative arts by competent hands. The beardless Christ, according to Christian iconography, is a more frequent type from the third to the

FIG. 5.

CHARLEMAGNE DALMATIC. (BEARDLESS CHRIST SEATED IN JUDGMENT.)

tenth century than later. The fact that both the bearded and beardless Christs appear in this one specimen suggests a compromise in date which goes in favour possibly of the work being of the ninth century, that is of the time of Charlemagne. The circular grouping of the subordinate figures around the central figure is remarkable. It is unusual, and, so far as I have been able to trace it, seems to have been a scheme of composition not often affected by certain of the monastic artists of the eighth century.

In an illuminated MS., a Sacramentary given by Charlemagne, about 826, to his natural son Drogo, Archbishop of Metz, we find an initial C, enclosing a circular grouping of figures

which represent the Ascension; Christ is the central predominating figure on the hill or mound, stretching his hand to that of the Almighty, which issues from the clouds. About and below the mound are the subordinate persons associated with the event. This MS. was probably written and illuminated at the celebrated abbey of St. Martin, at Tours, of which Alcuin, after rendering many years' service to Charlemagne, was appointed head early in the ninth century. This abbey of St. Martin's was one of the wealthiest in France, and some notion of its size and influence may be derived from the fact that there were more than 20,000 labourers or serfs employed on its domains, exclusive, of course, of the inmates of the monastery, in which the enrichment of the

FIG. 6.

CHARLES THE BALD, BIBLE ILLUMINATION.

library with MSS. engaged the special attention of Alcuin during the later years of his life. Under him the abbey rose to still greater fame as one of the best schools of writing and illumination.

Another splendidly illuminated MS. produced at Tours, and almost contemporary with the Sacramentary of Drogo, is a Bible presented by Vivianus, a successor to Alcuin in the abbacy of St. Martin, to Charles the Bald, who came to the throne of France in 840. From this Bible I have taken the celebrated full page illumination depicting its presentation to the king, who is the central figure, seated, with attendants near him on the right and left and the dignatories of the abbey below; all these subordinate figures are arranged into a circular group. (Fig. 6.) If this circular group of figures were put into a medallion and the architecture were omitted, we should still see more plainly how very similar the composition of it is to that of the medallion containing the beardless Christ on the Charlemagne Dalmatic.

Notwithstanding the views put forward in considerable detail by Monsieur Didron in his "Annales Archéologiques" in favour of this vestment being twelfth century Byzantine embroidery, I think, especially after seeing many of the daintily painted ornaments in other pages of the Vivian Bible and the Drogo Sacramentary, which are similar in style to many in the Dalmatic, that there are reasonable grounds to regard the Dalmatic as a fine specimen of work of the first half of the ninth century, which may, indeed, have been made at the abbey of St. Martin at Tours, but that it was worn by Charlemagne at his coronation in St. Peter's is less probable.

Its embroidery, showing great skill in stitching gold and silver threads so as to present a flattened surface, is remarkable and is typical also to some extent of a class of work that seems to have been much practised during a period from the ninth to the twelfth centuries, if one may judge from the few remains that have been preserved and are now available; the better of the embroideries, and possibly also the larger number of them, were made in England.

I now show an example of this class of fine English embroidery of the early tenth century which is preserved in the Chapter Library of Durham Cathedral. On the slide are three portions only of the stole, figured with Prophets and small conventional leafy ornament worked in fine coloured silks picked out with gold threads with which the background is wholly worked. The names of the Prophets in capital letters are worked close to the figures, of whom Hosea and Joel are in the centre piece: Isaiah on the left hand, and Daniel or Amos on the right. In a part of the stole not included on this slide, is an inscription in similar letters to the effect that it was made to the order of Aelfflaed, Queen of Edward the Elder, who reigned from 901 to 925, and was presented by her to Friedestan, who was Bishop of Winchester from 905 to 931. Winchester was the seat of Royalty in England, and its monastery became celebrated a few years later under the influence and direction of Dunstan, Archbishop of Canterbury. But even in the beginning of the tenth century Winchester was notable for its art in producing MSS. The Archbishop himself was a skilful artist, having acquired his skill when a monk at Fleury or Benoit sur Loire. The late Rev. James Raine, Librarian at Durham, suggests that the embroidery now before us was most probably made at Winchester. The design for it is a good example of the style of figure and ornamental designing that then prevailed at the best foreign, if not also English, monasteries. If the designs for these embroideries are not by English hands, it is not unlikely that some Frankish monks, illuminators, settled at Winchester, may have made the designs. However this may be, authorities on the subject seem to agree that the drawings of the Winchester school, after it came under Archbishop Dunstan, during the latter part of the tenth century and in the eleventh century, possess an English distinction which, especially in regard to fine freehand outline drawings, resulted from the grafting, as Sir Edward Maunde Thompson writes, of a foreign style upon that of the Anglo-Saxon draughtsmen, giving it strength and checking its peculiarities, freeing it to a large degree from what strikes us as grotesqueness, and fostering a realistic representation of incidents and human figures taking part in them. I venture to call attention thus particularly to the eleventh century Anglo-Saxon freehand drawing, as done in monasteries, on account of the interest attaching to a comparison between it and the drawing involved in such a needlework as the Bayeux Tapestry.

Many writers upon this historical needlework have not, I think, directed much attention to the value of such comparison as one of the means by which further light may be thrown

probably upon the origin and actual production of this unique embroidery. As a suggestion in this direction, I have taken two outline drawings from an MS. in the British Museum, known as Aelfric the Grammarian's Anglo-Saxon paraphrase of the Pentateuch, written and illustrated at the same time, namely, the eleventh century. These drawings are in the nature of illustrations and cannot be regarded as illuminations. In the first of them we have a scene of the two angels at table partaking of the hospitality of Lot who is entering the feast room; behind him follows a servant bearing a bowl. The attitudes of Lot and his servant and architectural features will be seen to be closely similar in style to many attitudes and architectural features in the Bayeux tapestry. Again, the second drawing (see Fig. 7),

FIG. 7.

OUTLINE DRAWING FROM ÆLFRIC'S PENTATEUCH.

which displays a large canopied hall and Lot speaking to his sons-in-law, is strikingly similar to corresponding figures and surroundings pictured in the Bayeux Tapestry. With the impression of these drawings fresh in our eyes, let us glance at a small part of the Bayeux tapestry, very fully described and discussed in Mr. Fowke's book on the subject.

Here we have King Edward the Confessor seated on a cushioned throne. With his right hand the King emphasises the remarks he addresses to two persons of rank standing before him. Of these one is undoubtedly Harold, who is taking leave of his master previous to quitting the court. Harold is wearing a moustache. And here we see him and his knights riding to Bosham. Harold and an attendant, having dismounted, enter the church: and are then entertained at some neighbouring house in a solar or upper hall, the place peculiarly set apart for eating and drinking.

The next incidents depicted are the sailing of Harold and his suite to the land of Count Guy, arriving on the coast of Ponthieu. Harold in full costume approaches the shore, the anchor of his boat is cast and he prepares to land. He is seized by the Count Guy, who conducts him to Beaurain and there imprisons him. Then follows a scene in which Count Guy, seated on a throne in a canopied hall, converses with his prisoner, Harold (Fig. 8). After this we have two knights who were sent by Duke William of Normandy to treat with Count Guy. And here the messengers returning to the Duke, who is seated, bearing in his left hand a sword.

Now all this needle-stitched embroidery naturally results in a heavier effect than that of the pen outline drawings of Aelfric's Pentateuch, but, notwithstanding this, I think that the gesture of the figures, the expression of their heads, their hands, legs, and feet suffice to show that the mannerisms of drawing in the one reappear nearly in the other. To this day the Bayeux needlework is officially called "la tapisserie de la Reine Mathilde." Of course it is not a real tapisserie or hanging woven in the well-known method, but is a needle-stitched embroidery. Moreover, as Mr. Fowke writes, there is nothing to connect the work with Mathilda. It was, he concludes, probably ordered by Bishop Odo to decorate his cathedral at Bayeaux, completed, however, forty-six years after the Norman Conquest. The length of the nave of the Cathedral coincides with the length of the embroidery. Whether Odo caused it to be designed and partly worked in England during the time when he was left by William the Conqueror in charge of Kent a few years after the Conquest, or whether it was done early in the twelfth century in Bayeux, are questions to which it seems impossible now to give conclusive answers. England was at the time becoming famous for her needle-stitched embroidery, and was noted for freehand outline drawing; it is possible that Normandy was equally so. The discovery of an original drawing for the Bayeux embroidery, signed and dated, would be an event of supreme archæological interest.

Very briefly let me recapitulate the main points touched on in this lecture. We have had evidence that the same character of darning or weaving embroidery was in practice from 1400 B.C. until the sixth or seventh century A.D.; that needle-stitched embroidery

was done from the fourth century B.C. up to the end of the eleventh century; that needle-stitched embroidery seemed to supersede the darning or weaving embroidery from about the eighth century A.D. onwards. We have seen indications of a connection more or less close between the art of MS. illumination and needle-stitched embroidery from the time of Charlemagne to the twelfth century, and we have had some slight suggestions of the domestic and other conditions under which embroiderers from the fourth century B.C. to the eleventh century A.D. have

FIG. 8.

BAYEUX NEEDLEWORK. (WILLIAM SEATED AND MESSENGERS.)

worked, and how at one period embroidery seems to have been used by wealthy Greeks only, and then more generally by Romans in the decoration of everyday costumes; and how in a succeeding period it seems to have been used almost exclusively for ecclesiastical vestments. The Bayeux Tapestry has shown us an exceptional use of embroidery as a means of recording upon a wall hanging a secular historic event. In my next lecture, I propose to treat chiefly of embroidery in England from the eleventh century onwards to the present day, and to give aspects of it corresponding with those few which have been dealt with in this evening's lecture.

THE HOUSING PROBLEM.

Not the least valuable portion of the Report of the Royal Commission appointed to inquire into and report upon the means of locomotion and transport in London, is that section of it which deals with the housing problem as affected by the facilities for locomotion. The over-crowding of the metropolitan area is, generally speaking, greatest in the central area, and tends to diminish towards the circumference. According to tables furnished by the statistical and other officers of the London County Council, the population per acre in the central area of London is 148, in the rest of the county excluding North Woolwich) 16·6, and in the rest of "Greater London" 2·5. Upwards of a million and a-half people live in the central, or most congested area, and the average weekly rents for workmen's dwellings are highest in the central and most crowded districts of London. In this area the average weekly rent of newly-erected, working-class houses is 3s. 3½d. per room, in the rest of the county 2s. 4½d., and in "Greater London" 2s. approximately. It is, in fact, impossible to re-house the working classes within the central districts, at rates which they can afford to pay without a heavy loss to those who undertake the re-housing. This is shown by the experience of the London County Council in connection with the formation of the new street from Holborn to the Strand, now in course of completion. Under the authorising Act, the Council was required to build workmen's dwellings in place of those that were demolished. For this purpose they bought the Bourne Estate, close to the site of the improvement. The cost price was £201,147, being the commercial value. They were obliged to write this sum down to £44,000, its value ear-marked for artisans' housing, and to debit the balance to the cost of street improvements. This was necessary to admit of charging rents within the means of the families to be provided for. And the families so provided for must be limited to those earning very substantial wages, seeing that the rents charged are from 9s. 6d. to 11s. per week for a three-roomed tenement, a rent that only the well-to-do artisan can pay. Even upon this rental there is a loss of nearly £60 per head of the persons re-housed. The buildings erected accommodate 2,640

persons, and the whole of this has fallen upon the rates.

The Royal Commission contrast this result with the outcome of the London County Council experiment at Tooting. They acquired land there at a price which required no writing down, and are now letting three-roomed cottages at from 7s. to 7s. 6d. per week, rentals which entail no loss. "The lesson to be learned from the two cases," says the report, "is confirmed by every housing scheme without exception that the London County Council has undertaken; whenever they have had to provide workmen's dwellings in central districts there has been a heavy loss. In effect the rents are largely paid out of the rates. In the few cases where they have provided dwellings outside the schemes have been self-supporting so far as the houses have been built." It may be mentioned that this is not the unanimous opinion of the Commission. In a separate report Sir Joseph Dimsdale denies that the housing schemes of the London County Council for providing workmen's dwellings outside the central districts of London have been self-supporting so far as houses have been built, and that in those cases there has been no loss of money at all. "Perhaps," says the City Chamberlain, "the largest of these is that of the Council's housing scheme at White Hart-lane, Tottenham, for accommodating 42,500 persons at an estimated cost of £1,972,602. It will not, I think, be denied that the rents, varying from 6s. 6d. to 9s. 9d. per week, for the Council's five-roomed tenements at Tottenham do not include rates, which are paid by the tenant in addition to the before-named rents. As the rates, even on such tenements, are exceedingly high, a workman occupying one of them would appear to be a prosperous man if able to afford something like 10s. 6d. to 13s. 9d. per week for his house accommodation. A six-roomed tenement not belonging to the Council can be obtained at Tottenham for less money than a five-roomed tenement under the Council." Be that as it may, the evidence taken by the Royal Commission would seem to warrant the conclusion at which it has arrived, namely, that it is not practicable to re-house the working classes in the central districts at economic rents.

It used to be assumed that the persons displaced in consequence of an improvement or a clearance would occupy the new buildings. It was upon this assumption that past legislation was based. But experience has shown that this is not the case. The interval of about two years which occurs between demolition and reconstruction disperses the persons actually displaced. "Even," says the report, "in cases where the London County Council has carried out clearances in sections, and has thus been able to offer new accommodation before complete displacement took place, little or no advantage has been taken of the opportunity. For example, in the Boundary-street area, out of 5,719 persons displaced, only eleven returned to the new buildings." Under the Housing of the Working Classes Act of 1903, a discretion is now vested in the Local Government Board which enables them to authorise re-housing at a distance from the demolished buildings instead of in close proximity as formally, but without facilities for locomotion this discretion cannot be generally exercised. The Commission insist very strongly upon the importance of locomotion as affecting the working classes, nor is the importance of facilitating rapid and cheap locomotion a matter that concerns only the working classes. It naturally affects the health, comfort, and efficiency for work of the whole community. Where facilities for locomotion have been afforded, the population does, in fact, take advantage of them to live outside London. This is illustrated by the increase in the population of Edmonton and of Walthamstow since the Great Eastern Railway Company commenced to run workmen's trains to these places. These trains were started in 1871, and the population of Edmonton at that time was 13,860, and of Walthamstow 11,092. In 1883, the company began to run three trains instead of two, and in 1891, the population of the two places had increased respectively to 36,351 and 46,346. In 1899 the five trains were increased to seven, and in 1901 the population had increased to 60,892 and 95,131 respectively, an increase largely due to the more rapid and cheaper locomotion. Leyton affords another example, the population having more than doubled in ten years from the same cause. The difficulty is to provide those facilities of locomotion which can alone make it possible for the working classes to take advantage of lower rents outside London proper. The railway companies are not generally prepared to construct lines leading to districts which are sparsely occupied. The railway commissioners have held that Parliament did not intend by the Cheap Trains Act to throw upon railway companies the duty of opening out neighbourhoods for the creation of new workmen's residential districts, and that they have consequently no power to order the running of a service of workmen's trains unless and until it can be proved that a demand for such trains exists along the line. Accordingly many places otherwise suitable for building workmen's dwellings are not accessible by railway, and others that are accessible cannot be utilised for residence by the poorer people working in London owing to want of trains of sufficient cheapness and frequency. A consequence of this state of things is a great aggregation of the working classes in those districts which have been opened out, and the presence of so many houses of comparatively low rental has discouraged the construction of better-class houses. For example, in Walthamstow, out of 18,600 houses, 15,000 are assessed at less than £16 a year, which means a low rateable value and a rate in the pound high in proportion. It is insisted by the Royal Commission that if the housing problem is to be solved, or overcrowding in London relieved to any appreciable extent, means must be provided for taking the popu-

lation into and out of London, "not in one or two directions, but in many directions, at rapid speed, frequent intervals, and cheap rates."

RUBBER PLANTING INDUSTRY IN CEYLON.

Writing in his Annual Administration Report in Jannuary last, the Director of the Royal Botanic Gardens, after referring to the statistics in "Ferguson's Directory" for 1904-5, came to the conclusion that, at the beginning of this year, there were about 25,000 acres under rubber cultivation, including all the kinds planted in Ceylon, Para, Castilloa, Ceara, &c. Not many years ago, Dr. Willis hazarded the opinion that, perhaps, 10,000 acres formed about the limit of area in Ceylon of suitable land available for the Para (Hevea) variety. We all, at that time, supposed that the Kalutara district presented the type of soil and climate required. But the ideas of rubber planters and scientists have been greatly widened since, "with the process of the sun," and through the valuable additional experience obtained. No one is certain now of the exact limit, whether in altitude or climate, for the profitable cultivation of Para; and nothing can settle this, but the result of experiments now being made in districts so varying in their character, elevation, rainfall, soil and climate generally, as Monaragala, Passara, Lower Haputale, the uplands of Uva, Lower Dimbula, Ambagamuwa, Kadugannawa, the various division of Matale, Dumbara and Medamahanuwara, the country from Kurunegala right along by Kegalla to Ratnapura, including the Kelani Valley, the Kalutara and Galle districts, and possibly some of the districts North of Colombo with stretches along the Northern Railway, and the plantings of some years ago near Trincomalee. Facing all the facts and figures presented to us on the present occasion, we feel difficulty in attempting to treat of the probable development of our great rubber industry during the next few years? Who dare say "whereunto this would grow?"—to quote classical words of old. For, already, we have to deal with one of the most important developments of planting ever originated and carried on in Ceylon. And here we must say that the gratitude of the colony is due to the late Drs. Thwaites and Trimen, for the great interest they took in obtaining the first rubber plants from Kew for Ceylon, and for their special care of the same. It must be remembered that Ceylon got the plants from Para which belonged to, and were intended for India*, and that these growing at Henaratgoda into large trees, now some 28 years old, are the parents of most if not all in Ceylon, the Straits, Southern India and Burma. Although Dr. Trimen gave full information in successive reports, year by year from 1883, yet progress among planters was very slow—owing to the time required to develop the tree, doubts as to the result in latex, and the great success of the tea bush—so that by March, 1898, Ceylon had not more than 750 acres of rubber, and by May, 1901, this area had only doubled; while in summing up the situation early in 1902 we supposed there were from 2,600 to 3,000 acres. Then a great start took place and for the middle of 1903, our estimate sprang up to 12,000 acres, and, as already stated, Mr. Willis considered this had more than doubled by the end of 1904, and that the colony had by January last 25,000 acres under rubber. The continued marvellous activity of the past six months and the strenuous way in which clearings have been formed for limited companies or private proprietors, apart from the free planting of rubber among tea, is shown by the fact that we find an increase of nearly 44 per cent. in the area cultivated since January last. No doubt in some cases clearings are returned which are only in process of being planted during the current monsoon season; but allowance can be made for such in accepting thirty-nine thousand acres as representing the area covered by rubber in Ceylon in July, 1905. The way in which we arrive at this result may be judged from the following totals worked out of the estate returns:—

	Acres.
Area under rubber only	20,096
" " rubber and tea	5,282
" " rubber and cacao	3,316

Number of rubber trees separately returned, 2,589,377, and counting 175 of these as equivalent to an acre on an average, we get an equivalent of 14,796 acres; and taking half the extent where rubber is returned above with tea and cacao, we get the grand total of 39,140 acres as representing the rubber industry of Ceylon at this time. With this we may contrast the latest figures for other Eastern lands, taking them from the Report of the United Planters' Association of the Straits for 1904:—

	Acres.
Malay Peninsula	30,000
Java	5,000
India and Burmah	5,000
	40,000

Ceylon and the Malay Peninsula are very likely about equal at present in their cultivated area.

As regards our exports from Ceylon, they commenced with 11 cwt. of rubber in 1889, but the Chamber of Commerce only began recording ten years later:—

* Seeds of *Hevea brasiliensis* were received at Kew early in 1876, and in August of that year 38 wardian cases with 1,900 plants were transmitted to Ceylon, where 90 per cent. arrived safely and were to be nursed and established in the Government gardens here for subsequent transmission through the Indian gardens to Assam, Burma, and other hot provinces of India proper.

1898......	2,792 lbs.	1902......	15,592 lbs.
1899......	7,910 ,,	1903......	44,798 ,,
1900......	8,233 ,,	1904......	77,212 ,,
1901......	9,072 ,,	1905 (½) ..	49,773 ,,

It only remains to afford an approximate value to the rubber-planted area in Ceylon, at this time. But that is a difficult matter. Taking the acreage at different dates, and apportioning a value such as we believe the owners would deem too low, we arrive at a total value of the rubber-planted land, and the cultivated rubber trees in Ceylon at this time of considerably over a million pounds sterling—that is an average of about £30 an acre, including newly-planted clearings or trees; but also including our oldest areas which are probably valued, in proportion to profit, at ten or twenty (?) times as much! It is impossible, in fact, in the present experimental, and, indeed, incipient stage of a great industry to arrive at a just value; but that the rubber-growing industry of Ceylon should already approximate to a total value of nearly 18,000,000 of rupees is a very notable fact in the planting history of the first of Crown Colonies.
—*Ceylon Observer.*

ENGINEERING IMPORT TRADE OF LOURENCO MARQUES.

A rather lengthy report has just been issued by the Foreign Office from H.M. Consul-General (Major Baldwin) at this important entrepôt. Lourenço Marques handled, in 1904, 23½ per cent. of the transit trade to the Transvaal as against 19 per cent. in the preceding year, owing to the cheap railway rates afforded, which are from 10s. to 15s. per ton cheaper than by other routes. Owing to the heavy shipments during 1903, the total transit trade was slightly less. There was a marked decline in imports from the United Kingdom, but general increases from Germany and other Continental countries. Major Baldwin lays much emphasis on a local condition "which has acted, and will continue to act with increasing severity to the detriment of British trade." The German East Africa line of steamers has a monopoly of the carrying trade between the competing European ports and those of the East Coast of Africa. Competiton by the Austrian Lloyd and by the British India Company's steamers is limited to a monthly service by each line, the English company suffering by transhipment at Bombay. The German company obtained its virtual monopoly by the aid of a heavy subsidy, and although freights may be regulated in agreement with other and indirectly competing lines, the existence of this "direct, regular, and efficient line of steamers. . . . . must tend to throw trade into the hands of the manufacturers to which the line belongs, and whose ports it is its principal business to serve." It is not to be wondered, therefore, that this, in conjunction with cheap inclusive freights from inland towns. Major Baldwin regards the outlook pessimistically and exclaims that "the gradual transfer of trade can only be a matter of time.". Still at the back of this pessimism there rests the fact stated a few pages further on that the actual tonnage of British shipping entering the port amounts to 854,027 tons, or 57 per cent. of the total. In 1903 66 per cent. of the tonnage was British, the decline in lead being due to a British decrease of 2·5 per cent. (a decline of over 22,000 tons), while the German tonnage increased by 51,638 tons.

As regards future requirements, exclusive of the Kaffir trade (in cotton, cutlery, &c.) the principal requirements during the next few years will be in connection with harbour works, docks, water and sewerage works and railways, and will cover all the machinery, sheds, pipes, cement, iron, timber and material used for the construction and equipment of such works. The local and the Transvaal firms are naturally in the best position to tender for these supplies, and the share of the orders which British manufacturers may obtain must depend upon the capability and energy of their representatives in South Africa. In this connection the writer of the report draws attention to the fact that the agencies for British manufacturers are in the hands of foreigners. "It is said that there is not much sentiment in business, but given only a slight margin between two articles there is probably sufficient sentiment to incline the agent to push the sale of those of his own country."

The following notes give particulars of the transit trade in the chief items among engineering goods in 1904:—

Sheet-Iron and Steel.—The total quantity dealt with amounted to 4,060 tons, valued at £41,992. Of this the United Kingdom supplied 3,000 tons, Germany 796 tons, Netherlands 146 tons, Belgium 78 tons, and United States 38 tons.

Rod, Block, and Hoop-Iron and Steel.—The imports were 6,422 tons in weight, valued at £82,973. The United Kingdom sent 5,358 tons, Germany 755 tons, the remainder being divided between Belgium, Netherlands, and the United States.

Iron Pipes.—Out of 4,091 tons, valued at £51,977, 2,630 tons came from the United Kingdom and 1,377 tons from the United States.

Galvanised and Corrugated Iron, weighing 10,990 tons, came, with the exception of 600 tons, from the United Kingdom. The total value was £137,031.

Machinery.—The trade under this heading is not catalogued with sufficient detail. Figures of tonnage are apt to be misleading in regard to articles of this kind. The total weight in 1904 was 9,096 tons, and the value £234,405. Of mining machinery, the United Kingdom supplied 241 tons, while Germany supplied 1,279 tons, and Belgium 147 tons. Cranes weighing 279 tons all come from the United Kingdom. As regards unspecified machinery, the United States sent 455 tons, Belgium 492 tons, Germany 2,374 tons, and the United Kingdom 3,713 tons.

HOME INDUSTRIES.

The Cotton Crisis.—The cotton industry in Lancashire, exceptionally prosperous during the last few months, is threatened with a wages strike. The operative spinners and the card-room hands, want the rise of 5 per cent. recently conceded to the operatives in the weaving section. Negotiations have been going on for some weeks without result, and the workpeople have decided to strike at the works on the 19th inst. unless the 5 per cent. be conceded. The decision of the masters not to give way has been determined by the adverse reports of the growing crop in the United States, and the consequent advance in price of ½d. per lb. A serious shortage in the crop is, however, hardly probable. The present American crop is not likely to be much short of fourteen millions of bales, and the least sanguine estimates of the new crop do not put it under ten millions of bales, which, with the enormous surplus from the crop now coming forward, should meet the world's requirements for 1905-6. The threatened strike affects not only the entire industry as such, but many subsidiary trades, such as bleaching, dyeing, and printing. Shipping and the railways would also suffer. The masters seem to think that a short stoppage, say for a month or six weeks, would not be altogether disadvantageous from their point of view. The short time last year, consequent upon the cotton scarcity, was followed by a period of great activity in the trade.

Labourers and Cottages.—Mention was made in this column last week of the cheap cottages at the Letchworth Exhibition. In the report of the Departmental Committee on the fruit industry the dearth of cottages in country districts is referred to as one of the difficulties in the way of the expansion of the fruit industry. But it is satisfactory to learn that many fruit growers take a broad view of their duty—and interest—in this connection. For example, Mr. Wise explained to the committee that at Toddington they had solved the cottage difficulty by building themselves thirty cottages having been erected at an average cost of £450 a pair, and let for £5 per annum each, which meant that the landlord received practically no interest upon the capital expended. But, said Mr. Wise, it was worth while "to fit up a good cottage to have a good man if they could get one," and he added they regarded it as part of the business of the fruit farm. It is to be remembered that the District Councils have the power to build cottages with the assent of the County Council, under the provisions of the Housing of the Working Classes Act, 1890. Hitherto little has been done in this direction, the time allowed for the repayment of loans being so short as to render the rent which had to be paid prohibitive to working men. But now that the provisions of the Housing of the Working Classes Act, 1903, authorise the extension of repayment from 60 to 80 years more should be done under it.

The World's Supply of Cotton.—Not much progress is being made in the cultivation of cotton in countries other than the United States. The movement for the promotion of cotton growing in West Africa, initiated at the memorable meeting at Manchester in May, 1901, has not as yet done very much to quicken cotton production in those parts In the West Indies the export has doubled during the last five years, but is still very small. It is only in India that there has been really large expansion in cotton cultivation. Egypt is practically stationary, and the world is still mainly dependent upon the United States for its supplies of cotton, as the following tables, giving imports of cotton into the United Kingdom, show:—

	1900.	1901.	1902.	1903.	1904.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Sierra Leone	...	...	...	26	212
Gold Coast	184	20	...	150	363
Lagos ..	221	105	56	4,418	3,443
Niger Protectorate ..	...	...	20	...	2,626
West India Islands	3,892	3,124	3 747	6,897	7,374
India. .	311,841	335,480	289,923	726,963	846,471
Egypt...	2 789,722	2,519,030	3,168,697	2 642,017	2,899,235
United States	12,190 169	13 221,303	12,177,136	12,153,019	13,310,446

And it must be remembered that whilst a few years ago the American consumption of cotton was quite insignificant, America now consumes nearly a third of her produce.

Blackberries.—Until very recently the commercial value of blackberries was strangely ignored. Growing freely in almost every part of the United Kingdom, and in some places, as in parts of Wales, nearing the size of a gooseberry, an excellent fruit, no no serious attempt had been made to improve, collect, and send them to the London market. But during the last year or two more attention has been given to them, and it looks as if they will soon be thoroughly exploited. When of good quality they fetch a price that must leave a handsome profit. Last year they were sold in London at 9d. and 1s. a pound, and it is said that this year over fifty tons will be disposed of to the public by London firms alone. There will be large and regular consignments from Kent, Derbyshire, and other blackberry-growing localities over the United Kingdom. Large shipments will be sent from Ireland to West of England ports, and it is expected that at least 50 per cent. more will come into the market this year than last. This new development deserves to be encouraged in every way.

A Novel Carpet Factory.—During the last two or three years the failure of the Scottish herring industry has brought great distress to many Highland fishing villages, and with the object

of lessening it the Duchess of Sutherland suggested a carpet factory which should utilise the wools turned to so many purposes in the Highlands. An experiment was made in the village of Helmsden, a fishing hamlet of a few hundred inhabitants in the extreme south-east of Sutherlandshire. An expert was engaged to teach the young women of the place the manufacture of carpets, and the first product of their looms is a carpet now on view at Messrs. Waring's. It carries a free and flowing scroll design accentuated in the vivid natural colours obtained from vegetable dyes. The carpet resembles an English Turkey, although its surface is a little more firm, and it is believed that when the looms are fully at work the price of similar carpets will not be high. They are to be known as the "Sutherland," and if only they can win public favour the benefit accruing to the Sutherland villagers should be great and lasting.

Receiving Orders and Trades.—In the Annual Report by the Board of Trade, under Section 131 of the Bankruptcy Act, 1883, there is an interesting list of the number of receiving orders and administration orders, under Section 125, made in the principal trades and occupations during the years 1903 and 1904. From this list it will be found that more of these orders are made against builders and less against pawnbrokers than any other class. Of the 4,546 made in 1904, 313 were applied to builders, and only 3 to pawnbrokers. Next came grocers, against whom 281 orders were made, publicans following close with 262, farmers, bakers, butchers, greengrocers, boot and shoe manufacturers and dealers, drapers and haberdashers, tailors, follow in the succession here given, officers in the army numbering 24 and Clerks in Holy Orders 8. Fifty-eight prosecutions under Section 166 of the Bankruptcy Act, 1883, were ordered during the year and of these 47 resulted in convictions. The largest number of charges were for obtaining to credit to the extent of £20, and next for not making full discovery of property.

GENERAL NOTES.

TEA AND INDIGO IN JAVA.—Some months ago it was pointed out in the *Journal* that Java might soon become a formidable competitor of India and Ceylon in the tea markets of the world. The figures found in Mr. Consul Fraser's report on the trade of Java in 1904 supports this statement. During the year the production of tea in the island increased by over 3,000,000 lbs., and a large area of new land was laid out for tea culture with Assam tea seed, which insures a further increase of quantity to be disposed of in the near future. The exports to the Netherlands and Russia show considerable advances, although, owing to the war, teas for the latter country were shipped *viâ* Europe, instead of *viâ* Dalny and Siberia. The growth of the tea exports are shown by the following figures, which represent the exports for the years named:—1899, 12,841,720 lbs.; 1901, 16,750,872 lbs.; 1904, 25,375,691 lbs. Last year the Netherlands took 13,102,916 lbs. of the total quantity exported, and the United Kingdom 9,918,408, Russia being third with 1,263,007 lbs. The war between Japan and Russia has apparently closed the markets of these countries to Java indigo. Planters have, therefore, had to ship their productions to the Netherlands, where only the better qualities have been able to compete successfully with synthetic indigo. In view of the difficulties experienced during the last few years in finding markets for Java indigo, it is feared that the acreage under cultivation will have to be largely curtailed.

THE FAILURE OF RUBBER PLANTATIONS IN MEXICO.—Mr. L. J. Jerome, H.M. Consul for the Consular District of Mexico, in a report dealing with the trade and commerce of his district, deals among other matters with rubber cultivation in Mexico. It is stated that the numerous plantations have not been successful as dividend earners, and that much harm has been done to the genuine concerns by the operations of a number of fraudulent undertakings having their headquarters in the United States. Mr. Jerome says:—"It is absurd to anyone who is acquainted with the labour of climate of the hot lands of Mexico to suppose for a moment that large profits can be made out of tropical plantations. In the case of genuine concerns, a comparatively small return can be expected for the capital outlay; a much smaller return than can be obtained in safer and less speculative investments in Mexico, but when the prospectuses and literature of tropical agricultural companies promise wealth in a very short time it is safe to assume that the undertakings should be left alone."

FOOD IMPORTS.—Amongst the food imports into the United Kingdom milk and cream, other than in the prepared form, are not generally included in the public mind, yet there is quite a considerable import of these articles. For example, the quantity of milk and cream exported from Cherbourg to Southampton during 1904 was as follows:—Cream, 49,848 gallons; new milk, 9,010 gallons; prepared milk, 44,764 gallons. A large trade is done from the same port in early potatoes, the actual export of early potatoes to the United Kingdom in 1904 being about 37,000 tons. The potatoes on the early market are put into trays (called boxes), writes Mr. Consul Loftus, in his report on the trade of Cherbourg (No. 3440, Annual Series) in late autumn, where, being arranged with the eye upwards, they sprout, and provided the light is allowed to fall upon them, a healthy green sprout, which can be planted in March, comes up at once, permitting much later planting than would otherwise be the case. This is the Jersey system.

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NOTICES.

EXAMINATIONS.

The results of the Intermediate Examinations (Stage II.) will be published to-day (Friday), and copies for distribution to Candidates will be sent to all Centres next week. The results of the Elementary Examinations (Stage I.) will be published early in September.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

SOME ASPECTS OF ANCIENT AND MODERN EMBROIDERY.

By Alan S. Cole, C.B.

Lecture II.—Delivered May 8th, 1905.

Whilst the Bayeux Needlework is, without doubt, the most important piece of secular embroidery which we know of, done in France or England during the eleventh or twelfth centuries, available evidence concerning English decorative needlework of the twelfth, thirteenth, and fourteenth centuries points to a preponderance of such as was in use for ecclesiastical purposes; and this may be accounted for, in some degree at least, by the facts that the Cluniac monks were enjoined under their rules to pay special attention to liturgical splendour, and that monastic establishments, many of which were under the Cluniac rules, were almost the only places in England at which there was sufficient organisation for producing such artistic work as decorative embroidery during the period in question. Conditions favourable to work-rooms of a purely secular or trade character did not arise until the thirteenth century. That they did arise, may be said to be due in great part to the eventual infusion of Norman habits of order into the English people, who thus became sensible of the value of social and political organisation, of law, method, and enterprise. In due course, then, under such conditions, it is not improbable that embroidery became a home occupation for wives and daughters especially, of men engaged in other crafts and callings; and we get perhaps a suggestion of this phase in the practice of the art characteristic of the thirteenth century from specimens of it, which have a marked affinity in ornamental design to that of scrolling metal work. Goldsmiths, who found it worth while to settle in some of the comparatively few important towns, carried on their work independently of monastic workshops, and probably supplied the gold thread, in some cases gold wire, with which much embroidery was made at the time for military, civil, and church ceremonial purposes. An early MS. mentions, "Goldsmythes furste and ryche jeweleres: And by hemself crafty Broderes." This appears to indicate the existence of some sort of kinship, as it were, between such craftsmen, and I will refer shortly to a definite instance of actual co-operation between such craftsmen in making an important bit of work.

But before doing so I wish to show you a slide from an engraving of the vestments reputed to be those of Thomas à Becket, which are preserved at Sens. The ornament of the mitre, and near the neck and shoulders of the cope, is of a scrolled metal style, and is embroidered in flattened gold thread. Very like it is the gold thread embroidery upon remains of faded silk which were found in an early thirteenth century tomb at Worcester, the tomb of Bishop Walter de Cantelupe.

More graceful in design, but of the same kind of needlework, are the fine open scrolls, encircling lions, on this slide (Fig. 9). This is part of some thirteenth century vestment, but from the absence of sacred symbolisms it serves also to suggest at least a style of orna-

ment for secular work at that time. The examples of such embroidery are rare.

King Henry III., as is well known, was an active patron of his country's arts, not merely of those followed under ecclesiastical direction, but of those independent of it, and one reads of His Majesty issuing instructions in 1244 that Edward Fitz-Odo, the son of Odo, a famous gold worker at Westminster, should make a dragon in the manner of a standard or ensign of red samit (or silk), to be embroidered with gold, and "his tongue to appear as though continually moving, and his eyes of sapphire and other stones." This clearly establishes such an inter-relation of art-crafts, as I allnded to above, and proves the employment of a

FIG. 9.

GOLD THREAD ENGLISH EMBROIDERY. THIRTEENTH CENTURY.

goldsmith, a jeweller, and a broderer upon a single important bit of work. On another occasion the King calls upon John de Somercote and Rogeri Scissori—art workmen in Lichfield—to produce richly embroidered silken robes, tunics, &c.

Upon this next slide we see gold thread scroll-work in combination, with figure subjects minutely stitched in silk embroidery. This is the front of a thirteenth century embroidered chasuble, the shape of which has been cut and altered since it was first made. The sacred figure subjects set within the four-lobed panels were doubtless derived from some MS. illumination and are admirable for the simplicity, distinctness, and apparent earnestness with which they are expressed. The combination of scrolls, panels, and figures is distinctive as a fourteenth century type of design for embroidery and worth noting. In old documents, inventions, and records of the thirteenth century for instance, entries concerning "opus Anglicum," "opus Plumarium" and the like often occur; and although it has grown to be a custom to accept "opus Anglicum" as a title peculiarly identified with fine split-stitch or chain-stitch embroidery of such sacred subjects as those we have just seen, I do not think that there is any more valid authority for accepting it in this way than there is for assuming that "opus Plumarium" is a long and short or feather stitchery of the thirteenth and fourteenth centuries. As I mentioned, last Monday, plumarius was the trade title of the Roman embroiderer; so that "opus plumarium" should mean embroiderers' work generally. The fame of English ecclesiastical embroidery was certainly very considerable in the thirteenth and fourteenth centuries. Many fine examples of it were sent abroad, sometimes as royal gifts, at others in response to definite commissions for vestments of "opus Anglicum." Still it may be well to note that a century or two before the English needlework had attained this celebrity, it appears that the typically English illumination of MSS. was also called "opus Anglicum." How much the famous embroidery owes to equally famous contemporary illuminations is a point which seems to me to be capable of a good deal more elucidation than that which I can try and offer to-day.

I have chosen one or two specimens of the kind of embroidery which seems to be fairly well authenticated as English of the thirteenth and fourteenth centuries, and also of one or two examples of MS. illumination of the same time. These may serve to show some relation of designs for MSS. to those for embroideries.

In describing a finely illuminated MS. of the thirteenth century, well-known as the "Tenison Psalter," the late Sir Edward Bond pointed out that in the course of that century the arts of painting and illuminating were becoming secular professions followed outside the cloister. To a similar extent embroidery must have been done also outside the cloister; but it would be difficult to hint at all satisfactorily how far the embroideries we are about to look at were made in monasteries or outside them. In any case the designs are clearly the work of

trained and versatile draughtsmen, whilst the needlework exhibits a technical finish, which, without offence to modern English workers, is unrivalled by their work as a rule.

I hope, from what I have said, that it will not be difficult for us to picture to ourselves that frequent co-operation must have been the rule between the draughtsman and the embroiderer—that is to say, between the illuminators and possibly their wives and daughters or those of other artistic craftsmen, such as goldsmiths.

In the fourteenth century, guilds for regulating the conditions of their work were beginning to be formed by the craftsmen themselves, and such organisation seems to have been a secular counter-move to the dissensions between the various religious bodies. It is claimed that, as early as the thirteenth century, a craft guild of embroiderers existed in London. This, however, may be doubtful, though from a legal document dated 15th November, 1293, belonging to the present Broderers' Company, it appears that the existing Broderers' Hall in Gutter-lane stands on a site then occupied by the workshop of William de Herslake—a saddler—which was close to the tenement of one Adam, a goldbeater. We may, perhaps, imagine that William de Herslake sometimes undertook to produce saddlery and horse-trappings decorated with embroidery and, if so, that Adam the gold-beater may have helped in procuring the gold thread or wire required by Herslake for such a purpose. However this may be, it is quite certain that, of the existing charters of the Broderers' Company, the earliest was granted by Queen Elizabeth in the sixteenth century, or some 300 years later than the times of William de Herslake the saddler and Adam the gold-beater. Amongst the Company's interesting historic possessions are two cups, one given in 1606 by John Parr, who was embroiderer to Queen Elizabeth and James I., and the other by Edmund Harrison, embroiderer to James I. and Charles I. The Company now-a-days encourages the instruction of women in embroidery by means of scholarships, which are tenable at embroidery classes conducted in various London technical schools.

Let us, however, return to the thirteenth and fourteenth century English church work.

We begin with the famous cope in the Victoria and Albert Museum known as the Syon Cope. A full description of it is given in the late Dr. Rock's "Textile Fabrics in the South Kensington Museum." The particular points upon which I wish to lay some stress are:— First, that the surface of the cope as displayed in this slide is entirely of needle-stitched embroidery. The ground is as elaborately stitched as the figures upon it. There is no employing of a rich satin or velvet and then embellishing it with occasional embroidery. As I have said, all that we see here is pure needle-stitched embroidery. From the technique of the needlework, let us turn to the design which consists of a sort of tracery or diapering, composed of overlapping quatrefoils. Simple diaper and trellis patterning was much in vogue in the thirteenth and fourteenth centuries. Within the quatrefoils and interspaces are various figures. In the highest central quatrefoil is Christ, crowned as a king, seated with the Virgin Mary. Below this is the Crucifixion. The single figures consist of the Apostles and of seraphims with crossed wings, a device which appears in much earlier illuminations. These figures stand out clearly in definition or silhouette against their backgrounds. Most of them have a slightly curved attitude.

Now some corresponding characteristics will be seen in the next slide, which is taken from a page of the illuminated MS., known as Royal MS. 1 D. 1 in the British Museum. Dr. Warner, keeper of the Manuscripts, who has very kindly given me valuable information in the course of the enquiries I have made, calls attention to an interesting coincidence: that one William of Devon was the writer of this MS., and living at the same time was one Master William, a painter to the king, and named in the Close Roll of Henry III. 1251-2. Whilst there may be no direct evidence that the King's painter actually illuminated the MS., it is not wholly improbable that he may have done so. The point, however, is not of serious importance, it is merely suggestive in connection with secular illuminators.

The page of illumination before us gives us the coronation of the Virgin, the Crucifixion, with the Virgin and St. John on either side of the Cross; seraphims with crossed wings, and St. Peter and St. Paul. These are all of rather more rigid appearance than the same subjects and figures in the Syon Cope, but there are resemblances in details between the two, sufficient, I think, to convey a sound suggestion of co-operation between illuminators and embroiderers in production of such church vestments. Such resemblance is stronger, I think, between this illumination

and the cope of opus Anglicum, known as the Madrid Cope, of which a coloured illustration is on the table.

Another cope, of slightly later date than the Syon Cope, is known as the Ascoli Cope, and has been the subject of much recent discussion. Its embroidery is as elaborate as that of the Syon Cope, and entirely covers the outside of the vestment. The underlying scheme of its design depends upon a repetition of separate roundels, which are cusped, containing figures representing sacred events relating to early and later Popes. We see only four of these roundels.

The next slide, however, gives us a full view of the cope. Taking the series of roundels horizontally, we have in the upper one a head of Christ in centre, and I ask you to note some special features of it—the arrangement of hair falling at the back of the neck; the shaping of the beard; the high forehead and the long nose. On each side of the Christ are martyrdoms of different Popes, such as St. Clement, St. Peter, St. Corneille, St. Marcel. The middle horizontal series has the Crucifixion in the centre, and right and left of it various teachers of the Church—St Sylvestre, St. Gregory, and others, each accompanied by two Bishops: the lower series consists of the Virgin and two angels in the centre and two Popes on either side, the four Popes being Innocent IV., Alexander IV., Urban IV., and Clement IV., who succeeded one another in the Pontificate from 1243 to 1268. A coloured illustration of this cope is exhibited in a frame.

The use of roundels and variously shaped panels enclosing figure subjects occurs in English illuminations of the thirteenth and fourteenth centuries, and the instance of shaped panels which I show is supplied by part of a page of a Psalter of the early fourteenth century. The style of the figure drawing, broadly speaking, corresponds with that of the Ascoli Cope, although the subjects are different. The face of Christ, however, has many points of resemblance to that on the Ascoli Cope, the high forehead, the long nose, the shape of the beard, &c.: suggestive of the relation between the work of the illuminator and that of the embroiderer.

Another type of embroidery design is given in this slide from a fourteenth century cope of red satin, worked with the same kind of needle-stitched embroidery as that of the previous copes. In this, however, the satin plays an important part in the design, as a ground to the symmetrical scrolling branches of the Jesse tree, the various figures in which are similar to those in the Syon Cope. There is a good coloured illustration of this Jesse tree cope in the room.

Specimens of secular embroidery of the fourteenth century are rare. One, entirely different in work from those of the Church vestments just seen, belongs to the Victoria and Albert Museum, and is a hanging of patchwork in coloured cloths. (Fig. 10). This method of decorative needlework is well suited to the rendering of broadly-treated designs. The example before us is called French; however, I see no particular reason why it may not equally well be called English. Forms of different shapes are introduced into it; at the same time, breadth and simplicity in treatment so suitable to the method of patchwork, are distinct features of this specimen. The late Dr. Rock, in describing it, suggested that the design probably represents incidents corresponding to some in the legend of Sir Guy of Warwick, an Old English metrical romance, written in the thirteenth century. The costumes depicted here are of a century later. The drawing and grouping of the figures and their surroundings appear to be such as one would be likely to see in an illuminated MS. of the legend.

Failing to find some contemporary drawing or painting of English embroiderers at work in the fourteenth century, I have had a slide made from a fresco by Ambrogio Lorrenzetti in the Palazzo Publico at Siena between the years 1337 and 1339, of an ideal prosperous town at that period. With some modifications in the architecture, it may serve to give approximately some idea of what would have been going on in an English country town—say Canterbury, for instance. To the left we have a boot-shop and men at work, beyond it a school; then a grocer's or wine-shop; in the background two women at needlework near the small alley, up which are passing mules bearing bales of wool packs, &c.

Now the three or four specimens of English thirteenth and fourteenth century embroidery, which we have seen, serve, I think, to convey a fair idea of the standard of technical finish attained in a time when its fame abroad was very considerable. However, soon afterwards it began to deteriorate, and it may be difficult to account for this. Both illuminating MSS. and carrying out embroideries from designs by illuminators were apparently becoming professions, to some extent at least, outside the

religious houses in which the main practice of such arts had been fostered. But it would seem that this outside or secular practice of the arts had not taken effective root, so that when the influence of monastic establishments began to weaken, as it did, the interests, of a comparatively minor art such as embroidery, suffered. The deterioration in English embroidery coincides with a period when conflicts were constant between secular and religious forces and when foreign and civil warfare was the rule, and yet it is interesting to note that progress was nevertheless being made in developing material resources, and manufactures of utilitarian value, however much the nurture of the decorative arts may have lapsed. The deterioration in embroidery is accompanied too by change in style of the ornamental and decorative elements used in the designs for it. Some part of this change may, I think, be traced to the effect brought about by the introduction into this country of foreign finely-woven ornamental stuffs, brocaded silks, satins and velvets, the like of which certainly were not, and probably could not, have been made here. Of many kinds and varieties, the designs of these imported fabrics were naturally attractive. They were more easily obtained than the less quickly produced embroideries, and so coming into general use amongst the wealthy members of the community, by the Court and the Church, they in large measure superseded embroideries. For embroidery to maintain any sort of position in such circumstances of competition, change in its ornamental appearance and in the amount of labour bestowed upon it was inevitable; and so we find that handsome woven stuffs were often adopted by the embroiderer as the ground-work for his enrichments. Embroidery used in this relatively economical and sparing manner came to play an almost subordinate part to fine-weavings: its designs gradually became flavoured with characteristics of woven ornament. Thus embroidery ceased to possess the charm of its earlier richness and individuality and descended to a diminished position in æsthetic importance. The progress of this change is often indicated in English Church embroideries made throughout the fifteenth century. Probably the greater number of church vestments consisted of foreign silks and velvets, rather sparsely sprinkled with embroidered ornaments and bordered with effigies of saints and such like, more often singly than in groups as in the earlier embroidery.

FIG. 10.

PATCHWORK: POSSIBLY ENGLISH OF THE FOURTEENTH CENTURY.

An example of this class of work is now thrown on the screen. It is a cope of rich purple velvet. The border, or orphrey and hood, are of embroidered figures; on the hood is a seated figure of God and on the orphrey are single figures of apostles and saints under Gothic canopies. Upon the velvet ground in the centre is the Assumption of the Virgin, above are two fleur-de-lys and below two Tudor roses. Three seraphims are symmetrically arranged about these devices, and beyond

again are various floral ornaments. All these details have less of that clean-cut definition and simplicity which are so characteristic in fourteenth century "opus Anglicum;" further, the epical or story-telling interest of the figures is small, and repetition of details is noticeable in the composition of the pattern. However, this is a good specimen of late fifteenth century embroidery.

In designs of later English embroidery we shall notice a still further decline in simplicity of treatment and epical or story-telling interest, whilst repetition with almost geometrical symmetry is the principal basis of the patterns. Hence the earlier imaginative and versatile MS. painter seems to have become succeeded by a somewhat mechanical and not very inventive draughtsman, who was more or less under the influence of repeating patterns as displayed in woven materials.

Although English church embroidery was almost dead in the sixteenth century, secular embroidery in England seems to have had some fair vitality. It was used a good deal in the costumes of the Court, and many of the modes of its use and characteristics of its ornament came from foreign sources into this country. For example, the work of Holbein as an ornamentist contributed to English acquaintance with an Italo-Flemish style of arabesque ornament which is reflected in the gold thread embroideries of King Henry VIII.'s costumes, so frequently shown in Holbein portraits. In another way professional embroiderers, such as were employed by Queen Elizabeth and James I., must have been influenced by the ornamentation of Chinese and Indian embroideries and printed cottons, newly brought into England towards the end of the sixteenth century. Repeated scrolling stems bearing and encircling flowers, birds, &c., are prominent features in many such Oriental works, and furnish a comparatively lively contrast to the sedate and balanced ornament which in large part had been derived during the earlier part of the century from architectural panels and friezes of an Italian Renascence type. Then again, books of patterns for embroiderers were published first of all in Venice and Paris, and came into circulation during the sixteenth century. One of them was compiled by Matthew Mignerak, an Englishman, described as a most expert worker in all sorts of linen work. Beyond this, one may note the influence of British affection for flowers, fruits and such like, which had long before expressed itself in manuscript illuminations, and now amongst other ways, showed itself in adapting such subjects as ornamental devices in embroidery.

A fine example of the class of the conventional arabesque embroidery which had a vogue in sixteenth century costume, is shown in this portrait of Charles IX. of France, painted by François Clouet, about 1570 (Fig. 11). The daintiness and intricacy of the stiff inanimate ornament are well displayed in the bands of gold embroidered work, the decorative value of which is enhanced by contrast with the intervening ground of plain velvet. The whole costume clearly exhibits the skill of a good professional designer. Such men were more numerous in France than in England. Similar ornament was carried into embroidered hangings and curtains. It is a style of design that has more academic accomplishment so to speak, than the peculiarly English style introduced into embroidery in the sixteenth and seventeenth centuries; indeed the English style exhibits many breaches of academic rules for the composition of ornament, and in this way points to an absence of that influence which, in Italy, for instance, arose from the traditions of continuous practice in the decorative arts. The English style attracts attention by reason of its independence and quaintness in conceit, a quality perhaps in some relation

Fig. 11.

Charles IX. Portrait by François Clouet.

to that of the conceits of Jacobean and Stuart poetry, which is said to have arisen from an aim of its writers to amuse by forcing the contrast between ideas and objects apparently remote and diverse. If such a suggestion is somewhat far-fetched, it does not clash with what, I think, was the fact, that there was a prevalent taste for certain extravagances, and, however well they may have been turned in literature, they were more absurd when represented in embroidery.

FIG. 12.

QUEEN ELIZABETH. PORTRAIT ASCRIBED TO ZUCCHERO, AND BELONGING TO THE DUKE OF DEVONSHIRE.

Portraits of Queen Elizabeth in one or other of her historically numerous and fancifully-varied dresses give one, I think, impressions of the better achievements of which English embroiderers were capable in her time. Here, for instance, is one ascribed to Zucchero, belonging to the Duke of Devonshire (Fig. 12). The Queen's underskirt is embroidered, perhaps, in cross or tent stitch, with a medley of plant, animal, and bird forms. There seems to be little feeling for balance, congruity, contrast, or ornamental arrangement, and even the colouring does not contribute much towards bringing the medley into harmonious unity.

The dress in Her Majesty's portrait at Hatfield is another instance of extravagance in conceits. The cloak is spotted with embroidered eyes and ears, along the sleeves are twisted snakes, and on the body of the dress is an orderly arrangement of floral sprays. At Hampton Court there is a portrait by Zucchero, which, if not of Queen Elizabeth, is of a lady of the period. Her dress is embroidered with continuous scrolls of fine stems, bearing all sorts of flowers. In between the scrolls are birds and butterflies and so forth. Another portrait of particular value for the careful drawing of the embroidery shown on it was exhibited under No. 269 at the Tudor Exhibition a few years ago. The embroidery was in black silk principally, and the pattern was of scrolling and intertwisted stems bearing various flowers and fruit shapes. In patterns of such scrolls there is more order and scheme than in the heterogeneous medleys previously referred to; and this order is, I fancy, a reflex in pattern designing of that with which English embroidery designers and workers were becoming acquainted, through late sixteenth century Italian weavings more especially, and through Oriental and Chinese embroideries gradually imported at the time. In a frame is a specimen of an ordinary Italian ornamental worsted weaving—the patterns of scrolls and pomegranates, &c. In another frame is practically the same class of pattern, done in black and gold thread English embroidery.

This slide also shows us something of this order or scheme of scroll design, strongly flavoured, however, with the English characteristic conceits of curious flowers and insects, embroidered on the linen jacket in coloured silks, the scrolling stems being of gold thread.

In the next slide we have a similar pattern of daintier scrolling stems, with flowers and leaves on a smaller scale, all, however, embroidered in coloured silks. In a frame is an interesting modern adaptation of this sort of pattern. It has been made by Miss Fellowes, of Birmingham School of Art.

Of a different character of work is the raised and padded embroidery, which was much used in James I. and Charles I. and II.'s times for boxes, mirror frames, &c. Medley of heterogeneous devices is the keynote of style in design for such work. This, as we have seen, arose in the Elizabeth period, but the class of raised and padded embroidery grew into greater vogue during the two succeeding reigns.

I have had an enlargement made of part of the lid of a Stuart box or casket in order that

the great skill and regularity of needlework may be seen. King Charles I. is seated beneath a canopy; his Queen is advancing towards him. Her dress is embroidered with a medley of floral devices. The curtains of the tent are decorated with the scroll and blossom pattern on a large scale, much the same as in the Elizabethan jacket we looked at. All about are odd disproportionate objects, absurdities, no doubt, yet factors in what has become a recognised style of embroidery design. Amongst the curious details are acorns rather larger in size than the pears near at hand; a moth or butterfly near the Queen is bigger than her head, and even than the dog above her, and so on.

A few years later in date is a toilet box or casket, covered with white satin, upon which raised and flat embroidery has been worked. This slide gives us the front of the box with one of its doors, or flaps, thrown back so as to show the flat flower embroidery of the inside in contrast with the raised work of the outside. Along the lid are quaint plant forms, a butterfly or two, and a rabbit and a squirrel. The sides of the box, which we do not see, are decorated with curious figures illustrative of Narcissus, Venus and Adonis, Apollo and Daphne, in Stuart dresses. The ornament on the lid of the box is arranged with intention and order; at the centre is a frame with a portrait, and balancing each other at the corners are grotesque birds, extravagant compounds of birds, shells, and butterflies, an indulgence in quaintness or conceit, which, however, was more vigorously expressed in marginal illuminations of MSS. some three hundred years earlier. The feeling for balance or order in arrangement may perhaps be considered to have been derived from Oriental work of later date. The skill of stitchery, which is admirable, is native. Deficient as we may have been in the art of ornamental design, our stitchery has been good; and, in connection with this, the numberless samplers of the seventeenth and eighteenth centuries which have recently turned up as valuable documents in the history of embroidery, show, as a general rule, how assiduously girls practised the working of many sorts of fancy embroidery stitches, not to prove the peculiar application of them to definite schemes of ornament, but rather to exhibit variety in beautifully taken needle stitches.

Towards the latter part of the seventeenth century the stitchery in single specimens of costume and hangings is often comparatively simple and uniform in character, however much the details of the ornament may be varied. For instance, in this quilted bodice almost the whole of the embroidery is of chain-stitch only. The flowers, leaves, and birds are fanciful in shape and treatment, much of this being borrowed from some Indian or Persian pattern: the distinct symmetry in the arrangement of these details is also derived from Indian or Persian patterns of the time.

Here, now, is a colour-printed cotton bed-cover from Masulipatam, which is but one type of many variations played for centuries by Indian or Persian Mohammedan pattern-makers upon a favourite motive inspired by the spreading branches of a tree, with birds seated

Fig. 13.

Cotton Curtain of English Seventeenth Century Crewel Work.

amongst them, and the ground busy with undulations and animal forms. In this particular print the design is a masterpiece of symmetry and ingenious interlacement, the branches well marked, and the background powdered with delicate leaf forms.

We can sympathise with an enthusiastic English embroiderer of the seventeenth century, who, upon seeing such a thing for the first time, would naturally almost become subject to the influence of its novelty, and so take ideas from it.

This portion of an English crewel embroidered curtain will perhaps illustrate my meaning (Fig. 13). The inclination to observe order and balance in arranging the details of the design is shown. There is well marked contrast between the stems and branches, and the small leaves, &c., powdered over the background. There are quaint bird forms;

the twisting tree stems grow from undulations or mounds, in which occur odd birds and animals. There are turns and touches which announce the English embroiderer, notwithstanding the underlying Orientalism of his design; and so we have a product which contributes to founding what in after years becomes a recognised "style," but is neither pure Oriental nor pure English. It was, however, sufficiently attractive at the time to call into life some trade in English worsted embroideries on linen, cotton, and canvas for curtains, cushion and furniture covers from the times of William and Mary into a good part of the eighteenth century.

In a corresponding way, trade in embroideries for costumes flourished and met a range of popular demand far wider than that of the mediæval Church or the Plantagenet Courts. This slide from an engraved portrait of King George III. supplies us with a typical instance of the kind of gold-thread embroidery on such a coat and waistcoat as was worn by His Majesty on state occasions. In formality and limited variety of pattern the embroidery has some affinity to that of many present-century Court dresses. The eighteenth century style of patterns in the embroidery on men's ordinary costume was chiefly French, owing much of its characteristics to naturalistic floral sprays and garlands, ribands, &c., such as are profusely displayed in silken weavings of the Louis XV. period: and a principal feature of the style in connection with costume is the repetition of the same details—the same bunches and sprays—along the edges of coats, and on the flaps of pockets.

The next slide is from an English dress-coat and waistcoat of fancy velvet, embroidered with coloured silks, and we notice the repetition of the same bunches of leaves and blossoms, as a ruling principle in the design or composition of the embroidery here.

It would, I am afraid, take us too far away from the particular considerations we have yet to deal with, to attempt any analysis of changes of fashion and taste, to trace their effects upon the course of the art of embroidery in this country, and to account for the decline in the employment of embroidery, whether for costumes or other decorative purposes, which appears to have occured during the first half of the nineteenth century. In any case I think that it would be seen that the ornamental designs, whether for such coloured or plain white linen embroidery as were made for general use, more than ever ran in a groove similar to that of patterns mechanically printed or woven, in which repetition of devices is unavoidable. Any efforts towards a more independent style which would give better opportunities for displaying the intrinsic merits of embroidery as an art handicraft, were few and far between: there seems to have been little or no public taste to encourage them, little appreciation in fact of individuality in such branches of ornamental art.

However, after about 1860 a change, which had been aimed at, does begin to appear. International exhibitions had been held at home and abroad; there were popular movements, due to private and to State enterprise, to direct attention to the study and practice in this country of ornamental art in its relation to taste in the production and use of things of everyday life: Schools of Art aided by Government in different parts of the country had been at work for some few years; Ruskin had lectured and written; William Morris was working in concert with Burne Jones, and influencing taste in many branches of artistic construction and decoration, including of course ornamental textiles, tapestry-weaving, and embroidery; two or three schools or societies were started for encouraging embroidery, the first one I think being under the presidency of Princess Christian, and another under Princess Louise (Duchess of Argyll), and from these emanated embroideries of individual character, some from designs by Burne Jones, Walter Crane, and others. Exhibitions of ancient embroidery were held, an Arts and Crafts Society was organised in London with offshoots in the country, a Home Arts Association of work centres throughout the kingdom came into being, and within the last twenty years or so, local authorities and others have formed classes and schools for systematic technical instruction, all of which have been agencies to develop general taste in working and using embroidery. These forces of varied character have been, I think, more favourable to independence and individualism of work than to reviving such uniformity and conventionality as seems to have prevailed in (say) English decorative art under monastic influences. Probably too it may be said that our modern British conditions are less restrictive than those of academical *régimes* which have obtained in France, where Central Government institutions, since the time of Colbert at least, have more or less set up official standards of art workmanship and manufacture. It is pleasant to find that much

of our modern embroidery excites the admiration of critics abroad, who appear to detect in it merits of vitality, and taste, of which we ourselves may not be entirely conscious. As may be gathered from what I have just said, the operations influencing embroidery in the kingdom are many, and indeed far too many for me to attempt to give illustrations of them in any adequate way. The most I can do now is to show only a few slides in respect (1) of a class of embroidery done for general trading, (2) of embroidery done by students in art schools as samples of their taste and skill, and (3) of embroidery done for special occasions by well-trained hands from designs by decorative artists.

Embroidery for general trading is executed sometimes in the homes of the individual workers employed; and sometimes in workrooms in which the hands employed are brought together under supervision. Close instructions are issued in respect of the work required; and the embroideresses are not called upon or expected to show any originality in taste or work. Their labour becomes specialised; indeed, it is said to such an extent, that the majority of the workers appear to be unable to use their skill in stitchery for mending their own clothes. Should the drafts of the pattern supplied to them be incomplete, they are not sufficiently acquainted with pattern drawing to be able to make good a deficiency. A considerable quantity of the embroidery made for general trading is in the nature of partly worked samples, ultimately sold at embroidery shops to dilettante embroideresses. The designs for these things aim at being popular, not very difficult to work, showy in effect and not necessarily in conformity with any particular canons of composition.

Here, for instance, are four specimens. The device or pattern is indicated on each one, either drawn or painted, and enough of it is embroidered to serve as a guide for its completion. Two of the samples have natural branches of flowers placed on them without ornamental treatment; the other two, as regards their details, seem to have some tendency towards what might be called ornamental treatment, though the choice of details may not exhibit an exercise of much judgment. The workrooms in which such samples are produced in hundreds, for the spring and summer seasons particularly, are apparently well lighted and well equipped, as may be seen from the illustration which has been kindly supplied to me (Fig. 14). All the work is being done in wooden frames. When it is a question of heavy gold thread embroidery on cloth or velvet, as for uniforms, iron frames are necessary to ensure proper tension of both the material and the embroidery worked upon it.

From trade work I pass to that done by students in schools of art, who produce it in connection with the technical studies they may be undertaking. On this slide is a design made a year or two ago at the Belfast School of Art, accompanied by a part of it worked out in embroidery. It is for a white linen counterpane. Linen embroidery in white thread is a considerable industry, well organised in the north-western part of Ireland.

FIG. 14.

INTERIOR OF A LONDON EMBROIDERY WORKROOM OF THE PRESENT TIME.

The next slide is of half of a painted design, and of the embroidery done from it, for a sideboard cloth, by a student of the Canterbury School of Art. The embroidery in this case is of coloured thread.

Of a more important grade is this panel of appliqué embroidery from the Plymouth School of Art, in which figures are introduced and a story-telling interest is given to the panel.

From the Glasgow School of Art is this design and its reproduction in embroidery. It is one of two or three panels illustrating the sands of Dee which were, I think, to be framed together as a fire screen.

Of another class altogether, and taking us back to the darning embroidery of the Egyp-

tians, Greeks, and Romans, are these specimens, which have been done quite recently under the supervision of Mrs. Christie, who gives instruction in it at the Royal College of Art. Two of them are pouches to hang from the belt and the third is a card-case.

A frame is shown containing an interesting example of a novel adaptation of darning to decorative figure design. The design and work are by Miss Keighley, of Plymouth School of Art. (Fig. 15.)

Fig. 15.

English Darning Embroidery of the Twentieth Century.

These different specimens serve to exemplify practice in embroidery as a branch of technical instruction in ornamental design, the provision for which is now considerable throughout the kingdom. In some places the arrangements for such instruction have been supplemented by organisations to help the successful students to carry on their work as a wage-earning industry, and commissions are given by private persons for the execution of special pieces of work, the designing of which involve expert skill. An interesting instance of work done under such circumstances is a mitre designed and embroidered in the convent of Poor Clares at the village of Kenmare in the south-west of County Kerry. This takes us back almost to a mediæval monastic condition of things, and I think that the nuns at Kenmare have shown much enterprise in organising their design rooms, and the employment of girls and women in the neighbourhood. Here, for instance, is a view of the Kenmare Convent design room. For the most part, as we see now, the designers are nuns; the embroidery is done partly by nuns and partly by girls under their direction. The specimen of their work which I now show is a bishop's mitre. It is of white satin; the ornament is adapted from devices found chiefly in Celtic filigree wirework on brooches, such especially as the famous Tara brooch which may have been made about the ninth century A.D., that is, at a time when Irish illuminators of MSS. were revered for their skill. Father Ultan is celebrated in a poem of that period, as a "blessed priest of the Scotic nation who could adorn little books with elegant designs. In this art no modern scribe could rival him, nor is it to be wondered at, if a worshipper of the Lord could do such things, since the Holy Spirit as an inspirer guides his fingers and raises his devout mind to the stars" The embroidery of the mitre is of coloured silks and gold threads. The second slide gives the back of the mitre, with the ends of the lappets embroidered with modern editions of ancient Irish ornaments.

I close my illustrations of modern English embroidery with two specimens of special design by Mr. F. Vigers: the embroidery is by Miss Symonds and her assistants.

The first is a casket or reliquary for use in connection with church ritual (Fig. 16.). The embroidery is of coloured silks and gold thread, in cross or tent-stitch on canvas, and furnishes the panels on the outside of the casket, which represents heaven as a building, with an open arcade and golden gate, and grill between the columns, within which are all sorts and conditions of men. St. Peter is at the gate, about to open it to a mortal who seeks admission: naked as he came into and left the world. In the upper arcade on the lid are angels rejoicing over the repentance of man. The colours in the original are brilliant and harmonious—the uniformity of stitch results in pleasant uniformity of texture—but the kind of stitch involves angularities, which are not quite agreeable in the rendering of curved shapes, as for instance in the arches, where slight distortions occur. On the other hand, the completeness of the work, the

brightness and sparkle of colour, the epical interest of the design outweigh the drawbacks which I mention. The casket seems to me to be a fresh, attractive, and individual embroidery.

My last slide is from the embroidered velvet train which was worn by H.M. Queen Alexandra on the occasion of the King's Coronation in 1902. This too was designed by Mr. Vigers. It was embroidered by many of Miss Symonds's pupils, who, amongst others, took part in the work. The scheme of design, with its symmetrically massed ornament, inclosed in borders, is obviously well suited to the shape and purpose of a train: the formality of the design is simple, but none the less accords

FIG. 16.

CASKET OF ENGLISH CROSS STITCH EMBROIDERY. TWENTIETH CENTURY.

with the spirit of the ceremony of state for which it was made. The balanced scrolling stems rising from the ancient form of Plantagenet Crown typify a growing rose tree as an emblem of England, on to which become engrafted the thistle of Scotland, and the shamrock of Ireland. These scrolling stems spread upwards, encircle the star of India, and culminate in the modern Imperial Crown which is repeated several times with sound, enriching effect over the main ground of the velvet train. Below the Plantagenet Crown the roots of the English tree are seen to be set amongst fleurs-de-lys — a reminder of the country's early connection with France. Thus a good deal of pleasant fancy underlies the ingenuity of ornamental design. The embroidery is principally of gold thread: the centres of the Tudor roses are silver: the floral parts of the thistles are picked out in purple silk, and the leaves have a touch of green. The technical difficulties to secure evenness in workmanship with comparatively stiff materials must have been considerable, but they were surmounted, and as we see in a way worthy of the traditional skill displayed in "opus Anglicum."

I have attempted in my lecture this evening to carry further the suggestion contained in my first lecture, that embroidery to be good and interesting, must be based on well-considered and well-expressed design. With primitive people, and others who follow traditional conventions, Chinese, Indians, and Mohammedans, for instance, the design and execution of single pieces are generally due to one person; but, I think, the results on the whole, are monotonous to western eyes, and have a strong impress of an *air de famille*, with little, if any, expression of individuality. On the other hand, in Europe, the designer has, as a rule, been a different person from the embroiderer. To achieve success, the two have co-operated; the designer paying due respect to the conditions and limitations of material and method, the embroiderer paying due respect to the form and colour which he is set to reproduce. English work of the thirteenth and fourteenth centuries seems to show that this was the case. Eccentricities of design in Elizabethan and Stuart embroideries point to a different condition perhaps. The embroiderers seem to have worked independently and without matured and carefully-prepared designs. Afterwards, say from early in the eighteenth century and up to within the last fifty years, designs for embroidery appear to have been made chiefly on the lines of mechanically repeating patterns, and the results have been comparatively uninteresting, tame, and not even amusing in eccentricity. No doubt we are now in the midst of a condition of things the tendency and effect of which cannot be summed up and thoroughly described. In some respects they seem to make for a good deal of vapid and tawdry display, quickly seen and quickly tired of; in other respects they seem to make for stimulating and thorough work, which is worth having and keeping, because, in making us look at it and think about it, it interests and refreshes us.

I thank you very much for the patient attention you have given to my remarks. I am sure that you will agree with me that the specimens lent by the Board of Education from the Victoria and Albert Museum have been of great interest, and have much increased the value of the other illustrations.

TRADE MARKS IN GERMANY.

It is curious to find that the Germans continue the practice of marking goods manufactured in Germany with British names and phrases so as to misguide the buying public. German industry is aiming in many directions to free itself from foreign dependence, to become as national as possible, but the preference for foreign commodities and foreign fashions has still to be reckoned with. All trade marks and names granted in Germany in the course of each month appear in the monthly issue of the *Waarenzeichen Blatt*, an official publication issued by the German Patent Office. In two recent issues alone 42 British marks and designs were directly applied for by Germans (exclusive of British marks applied for by British subjects through a German patent agent). Among such names and phrases were, *e.g.*, "The Greater Britain," and "The Cape to Cairo" as names for brushes; "Lord Kitchener" and "Lord Curzon" as names of knives, scissors, &c.; "Balmoral" as a name for earthenware; "Queen" as a name for razors, &c. Mr. Consul-General Oppenheimer (No. 3445, Annual Series) classifies the cases under three headings. The first class includes cases in which British denominations have become something in the form of technical words, *e.g.*, "linoleum," "inlaid linoleum," "buckskin," "Manchester," "waterproof," "Albert biscuits," &c. In some of these cases there is a tendency to replace the technical names by German ones, which are then enclosed in brackets, so that the present time marks a period of transition.

Between this class of manufacture and those who may be suspected of an attempted deception of the public at home and abroad is a second class, namely, those who, while not directly aiming at deception, appear to hope for it, for some combine with the English technical word another English word for which there appears no German equivalent, and which, in a way, has been received in the German vocabulary, *e.g.*, "sport razors" and "all-right bicycles." Others, again, copy the packing of the better-known British commodity as closely as possible, though introducing the name of their own firm, *e.g.*, biscuit tins. Others again, while avoiding the British trade names of wide reputation, concoct a name resembling the British one as near as the law will allow, *e.g.*, "Yvette cream" instead of "Everett cream," Saponia instead of Sapolio, &c.

As to the third class, who use purely English phrases to describe their German goods, Mr. Oppenheim points out that a difference ought to be drawn between those branches of manufactures in which it is said to be merely a custom of trade to use British names or words, and those branches in which no such custom can be pleaded in mitigation of the practice. Concerning the former, the practice of giving to articles of male attire British names is so general, that the shops selling these goods themselves go by British names, such as "Jockey Club," "Old England," the "Prince of Wales," &c. Concerning the latter, it can only be said that their goods bear British names and phrases when German ones ought to be used pure and simple. An important item in their mode of procedure is the trade-mark, the design of which is, as a rule, so devised as to deceive even those who examine it closely. The design, moreover, often bears at the bottom, the words, "trade-mark." Though this term may at one time have been a German technical word, it has long since been superseded by the German technical term "Schutzmarke," or "Waarazeichon." Among the articles thus sold are all kinds of perfumes, soaps, bay-rum, cosmetics, confectionery, jams, marmalades, canned provisions, biscuits, all kinds of paper and cardboard, &c.

FOREIGN TRADE OF JAPAN.

The annual return of the foreign trade of Japan for the year 1904, recently issued by the Department of Finance at Tokio, presents the statistics of the commerce of the country during the past year, as well as data showing the proportion of its trade with each of the foreign countries. Japan has certainly made rapid progress in her foreign commerce during the past ten years, and her trade with the United Kingdom and the United States shows a particularly rapid growth. The imports into Japan in 1904 were the largest on record, being £36,900,000 in value, as against £31,600,000 in 1903, £28,600,000 in 1900, and £13,300,000 in 1895. Exports from Japan in 1904 also established a new high record, being £31,800,000 in value, as against £28,800,000 in 1903, £19,800,000 in 1900, and £14,000,000 in 1895. Thus the imports into Japan have increased by £23,600,000, and the exports from Japan by £17,800,000. During the past ten years Japan has imported £40,000,000 more than she has exported, the excess of the imports over the exports averaging about £4,000,000 annually during that period. An examination of the statistical table showing the foreign trade of Japan by countries, indicates that Japan imports most largely from Great Britain, British India, the United States, China and Germany. These five countries supplying about 77 per cent. of her total imports. Of the total imports into Japan in 1904, amounting to £36,900,000, the United Kingdom contributed to the extent of £7,400,000, or 22·2 per cent.; British India (including Straits Settlements) £7,045,000 or 19 per cent.; the United States, £5,800,000 or 15·7 per cent.; China £5,430,000 or 14·8 per cent., and Germany £2,860,000 or 7·7 per cent. Of the exports from Japan, amounting to £31,800,000 in 1904, the principal countries of destination are the United States £10,080,000; China £6,770,000; France £3,610,000, Hong Kong £2,800,000; Korea £2,030,000; Great Britain £1,750,000, and Italy £1,200,000, these seven countries taking about nine-tenths of the exports

from Japan. It will be observed that the United States is by far Japan's best customer, exports to the United States from Japan representing about one-third of her total sales to foreign countries. The relative progress made by the United States and the United Kingdom in the import trade of Japan is seen in the following figures:—In 1884 the United States supplied 8·4 per cent. of Japan's imports, while the United Kingdom supplied 43 per cent.; in 1889 the United States supplied 9·3 per cent., the United Kingdom 39·4 per cent.; in 1894 the United States supplied 9·3 per cent., the United Kingdom 35·9 per cent.; in 1899 the United States supplied 17·3 per cent., the United Kingdom 20·3 per cent., and in 1904 the United States supplied 15·7 per cent. and the United Kingdom 20·2 per cent.

Since the revised Customs tariff came into operation in Japan in 1899, there has been a rapid increase in the Customs receipts, which rose from £881,000 in 1899 to £1,495,000 in 1904.

FLOWER FARMING IN AUSTRALIA.*

Although nature has become largely replaced by science in the manufacture of choice perfumes and essential oils, the demand for flowers for industrial purposes in various parts of the world is being steadily maintained, and in Europe and America flower farming is conducted on an extensive and remunerative scale. Yet in the countries of the Commonwealth, so rich in plants yielding delicious perfumes and valuable essential oils, little or nothing has been done, so far, to practically utilise the advantages thus afforded. Systematic flower farming is still in its experimental stages, and there exists an almost un-untouched field of illimitable extent at the command of those possessing the necessary capital and experience in the manufacture of perfumery and essential oils, coupled with the advantage of an abundance of mutton fat, so largely used in the perfumery trade, at minimum prices. In Australia all the garden flowers of Europe and Asia, especially those emitting the richest fragrance, are found growing in unsurpassed luxuriance, many being obtainable nearly all the year round, their profusion and cheapness proving how easily they are reared. Several of the essential oils obtained from the leaves of native plants are really perfumes, and their chief use is in scenting soaps and other preparations. The quantities used are small, most of the plants being wild. Among the native perfume-yielding plants which remain unutilised are several varieties of acacia, including a few which furnish a scented wood. The *Acacia farnesiana*, which is largely cultivated in Italy and the south of France—the well-known pomade, called "Cassia," being produced by placing the sweet scented flowers in melted mutton fat or olive oil, until the latter become impregnated with their odour—grows plentifully in many parts of New South Wales and other States; and another species of acacia, familiarly known as the golden wattle, is equally useful as a perfume plant; as is also the native laurel, or mock orange. Among the plants from which sweet-scented and other oils may be obtained are the native sassafras, peppermint, bloodwood, blue gum, mountain ash, white gum, ironbark, woolly butt, spotted gum, tallowwood, messmate, red gum, poplar box, and other species of eucalyptus; ridge myrtle, tea-tree, native peppermint, dogwood, and turmeric. The essential oil of the red gum has been found a reliable remedy for chronic dysentery and diarrhœa, and that of the Moreton Bay ash makes an excellent furniture polish. The oil obtained from the native sassafras resembles, in odour, ordinary sassafras oil, with an admixture of oil of caraways, and is used for medicinal purposes. Eucalyptus oil possesses many valuable qualities, and is said to possess the power of destroying bacteria, or animal life. Its antiseptic powers have been fully recognised by the medical profession, and by many it is preferred to carbolic acid in the treatment of wounds. The leaves of the various kinds of eucalyptus are found useful in preventing or removing scale in boilers. The oil of the mountain ash, a common species of eucalyptus, dissolves gutta percha readily, and can be used, like kerosene, for lamps, having a greater illuminating power, a pleasant odour, and absence of liability to explosion. Three ounces of the oil have been found sufficient to scent eight pounds of soap, at a cost of one farthing per pound. The oil obtained from the stringy bark is found to be more efficacious, in many complaints, than the ordinary English peppermint, being less pungent and more aromatic. The oil of the white gum has been suggested as a soap perfume. The woolly butt oil possesses the remarkable property of imparting an indelible stain to paper, but at present it has not been utilised for commercial or industrial purposes. The oil of the grey gum possesses a delicious citronelle odour, and makes an excellent soap perfume. Several varieties of the tea tree furnish an oil possessing most, if not all, of the properties of cajuput, so largely used in India as a remedy for rheumatism. Practically, the number of native shrubs and trees in the Commonwealth capable of being utilised in the manufacture of perfumes and essential oils is without limit, and when the large quantities of either product, obtainable from comparatively small proportions of bark or leaves, is taken into consideration, it will be seen that in this direction Australia posseses exceptional advantages for those possessing the requisite capital and experience to establish large and remunerative productive industries. It may also be mentioned that the olive, castor oil plant, and linseed grow luxuriantly in the Commonwealth, and are easily cultivated.

* Communicated by Mr. John Plummer, of Sydney, New South Wales.

HOME INDUSTRIES.

Motors and the Post Office.—Allusion was recently made in the *Journal* to the way in which the motor is affecting many industries, among them the carriage of letters. The report of the Postmaster-General on the working of the Post Office, just issued, shows that considerable extensions were during the past year made to the use of motor vans for the conveyance of mails, and that there has been a substantial advance in the reliability of the services already established. On some services the results have been, according to the official statement, "highly satisfactory," but on others the motor vans employed have not yet shown themselves so trustworthy as horse vans. It is, of course, imperative that vans used for mail services should work punctually and regularly, and it is necessary therefore to proceed with caution in extending the use of motor vans, and to exercise care in the selection of the contractors for the services. Motor services have been established between London and Epping, London and Redhill, London and Brighton, Manchester and Liverpool, Birmingham and Warwick, Birmingham and Worcester, Newcastle and Sunderland, and Northampton and Hitchin, and also between some of the London district offices. The employment of motor vans has in many cases resulted in an acceleration of the service, and where the loads are heavy and the distances considerable, in a substantial economy. Arrangements have also been made for the establishment of motor services between London and Hastings, with a branch from Tunbridge Wells to Eastbourne.

The Brewing Trade.—The Report of the Commissioners of Inland Revenue supplies some instructive figures bearing upon the brewing industry and the consumption of beer and spirits. The disappearance of small breweries is very noticeable, and is shown by the number of licenses, issued to brewers, for sale. In the year ended March, 1895, the number was 8,863, but since then there has been unbroken decrease until for the year ended March, 1905, the number of licenses issued was only 5,164. These figures relate to England only, but similar decreases are shown for Scotland and Ireland, the number of licenses issued throughout the United Kingdom having fallen, within the period named, from 9,050 to 5,311. The great decline in the practice of private brewing is illustrated by the figures which give the number of licenses issued to brewers, *not* for sale. In 1895 they numbered, for the United Kingdom, 17,041, in 1905 only 9,930, and the decrease is shown in all three kingdoms: in England, from 16,706 to 9,863; in Scotland, from 274 to 67; whilst in Ireland, the solitary one of the earlier year disappeared in 1900.

The Consumption of Beer.—If the figures showing the quantities of beer retained for consumption in the United Kingdom are taken, it will be found that there is shrinkage. The estimated consumption of beer per head of the population of the United Kingdom was highest in 1899-1900, when it rose to 32·28 gallons. Since then, there has been continuous decrease, until for 1904-5 it was only 28·44. It is, however, remarkable that the decrease has not extended to Ireland, if last year is excepted. Whilst in Scotland, as in England, the quantity of beer consumed shows steady decrease from 1899-1900, in Ireland, notwithstanding diminishing population, it continued to increase up to and including 1903-4. The figures below will make this plain:—

	England. Barrels.	Scotland. Barrels.	Ireland. Barrels.
1899-1900 ..	31,609,851 ..	1,931,295 ..	3,037,010
1903-1904 ..	29,705,535 ..	1,675,000 ..	3,358,102
1904-1905 ..	29,107,028 ..	1,596,715 ..	3,196,381

These figures are remarkable. They not only show that the shrinkage in consumption has been much less in Ireland than in England and Scotland, but that, having regard to population, and speaking roughly, the amount of beer retained for consumption in Ireland was about as much again as in Scotland.

The Consumption of Spirits.—The figures relating to the quantities of home made spirits retained in England, Scotland, and Ireland for consumption in the ten years ended 1904-5, point to a somewhat different conclusion. It may be convenient to give Tables as before. As with beer the high-level mark of consumption was reached in 1899-1900:—

	England. Proof galls.	Scotland. Proof galls.	Ireland. Proof galls.
1899-1900 ..	25,623,177 ..	8,380,378 ..	4,713,178
1903-1904 ..	22,974,805 ..	7,192,247 ..	3,936,059
1904-1905 ..	22,661,420 ..	6,758,901 ..	3,737,623

Here the decrease has not been unbroken, 1902-3 showing an increase in all three countries upon the previous year, but taking the five years there has been considerable decrease all round, the shrinkage in the Irish consumption of home-made spirits being somewhat more than in Scotland. Taking the ten years 1894-5 to 1904-5 the quantity of home-made spirits retained in the United Kingdom for consumption rose from 29,291,300 proof gallons in the earlier year to 33,157,944 gallons in 1904-5, being ·75 proof gallons per head of population in 1894-5 and ·77 in 1904-5. If instead of confining the return to home-made spirits, the consumption in the United Kingdom of all kinds of spirits, whether home made, colonial, or foreign is taken, 1899-90 retains its place as the year of greatest consumption, and there was a similar slight increase in 1902-3. In 1894-5 the quantity of spirits of all kinds consumed per head of population was ·95 gallons; in 1899-00 it had risen to 1·17, in 1904-5 it was only ·93.

American Grain Exports.—In the minority report of certain members of the Royal Commission on Supply of Food and Raw Material in Time of War—the minority report signed by the Duke of Sutherland, Mr. Chaplin, Mr. Wharton, Sir Henry Seton-

Carr, and Mr. H. H. S. Cunynghame—exception is taken to the prediction of the main report that the exports of wheat from the United States to Great Britain will diminish yearly. Far from being of this opinion, the gentlemen named consider that these exports "are far more likely to increase than to diminish, for a time at all events, and for this reason. In 1903 and 1904 the crops in the United States were deficient, especially in the latter year, whereas the estimate of this year's wheat crop, made by the statistician of the New York Produce Exchange, on the basis of official reports on the crop, is 728,000,000 bushels. If this estimate is accurate, it would indicate the largest crop on record, with the single exception of 1891, when it was 748,000,000. In 1904, the crop was only 552,000,000 bushels, and there is every reason to expect again an increased export from the United States larger than that amount."

Decrease in Exports.—Time only can verify or rebut this opinion of the dissentient Commissioners, but it may be pointed out that the latest official returns show no recovery in the exports of wheat from the United States. The explanation given by Mr. Consul Finn, in reporting on the trade and agriculture of the consular district of Chicago, under date March 16th last, deserves attention. "The wheat crop of the States," he writes, "has steadily decreased during the past four years, which can partly be accounted for by a decrease of acreage in this crop, but chiefly to the lessened yield from repeated crops on the same land, without any interval. The farmers who grow corn (maize) return the stalks to the ground as fertiliser, and alternate the crop with oats, besides often feeding cattle and hogs on the product, thus making a return to the land; but the wheat farmer in the United States goes on with the same crop year after year, returning nothing to the soil, until it no longer produces a paying crop. The land is then used for maize or oats, and under the new system becomes of value again. With the increasing home demand for wheat and the decreasing returns, more wheat will be grown profitably on land now used for maize, and grown in rotation with other crops . . . . In the older settled States in the East the farms are increasing in size, as dairying has shown itself to be more profitable there than raising crops, but in Illinois, Indiana, and Ohio small fruit and chicken farms have reduced the average acreage by a great deal."

The Home Supply of Wheat.—Be that as it may, the shrinkage in the home acreage under wheat continues. Whilst population and consumption increase the home production grows less. The total wheat crop of the United Kingdom at the present time amounts on an average to about 7,000,000 quarters. From this 15 to 20 per cent. must be deducted for grain unfit for milling or required for seed and other farming purposes. The quantity required for consumption in 1903-4 reached over 32,000,000 quarters, giving a *per capita* consumption of 364 lbs., showing an increase of 22 lbs. on that of the quinquennial period immediately preceding. The following figures show the shrinkage in the area of cultivation during the last fifteen years, as compared with the consumption :—

	1889-90. Qrs.	1899-1900. Qrs.	1903-4. Qrs.
Production	9,485,451	8,407,571	6,102,348
Average consumption per week ..	521,000	560,000	622,000

Of the 32,000,000 quarters of wheat required last year for home consumption, not more than 20 per cent. was of home growth. Probably the bottom point in home production has been reached. The demand for straw for various purposes must always operate to impede the decline in the production of wheat in this country, and the chief cause in the decline, the fall in price, has been checked, whilst probabilities point to some recovery in the immediate future.

Partnership Benefits.—Firms who would hold their own in these days of fierce competition, have to see to it that the per-centage of working expenses is as low as possible. Improved machinery, better means of distribution, and the like, tend to this desirable end, but community of interest as between employer and employed is less often invoked. And yet it may be made a potent factor in the creation or maintenance of business prosperity. Recently a very old established firm, whose relations with their workmen have always been excellent, found themselves confronted by competition that made it imperative to effect savings if the profits of the business were not to be seriously curtailed, and it was decided to adopt what may be called partnership benefits. Under the new arrangement each employee who has served the full twelve months receives one week's wage for every one per cent. earned and available for dividend over 6 per cent., that percentage being fixed as a fair return upon the capital invested. Those who have not served for the full twelve months, receive a bonus for 9, 6, and 3 months' service in like proportion. Interest on deposits of 20s., or over, is allowed as follows:—5 per cent. for deposits remaining for not less than 12 months, 4 per cent. for deposits remaining for six months, 3 per cent. for deposits remaining not less than three months. The whole or part of the deposit may be withdrawn on giving seven days clear notice. The scheme is said to work admirably. Now that they are to some extent partners in the business, the men take a keener interest in it, they are more careful to avoid waste of material, more eager to give the best of their work. The managers of the business are able to trace a distinct diminution in the cost of production to the better returns given by the workmen for the wages they receive, and the substantial addition to those wages consequent upon the adoption of the bonus scheme insures the maintenance of the happiest relations between employers and employed.

CORRESPONDENCE.

THE ETYMOLOGY OF "EMBROIDERY."

I am stirred to recast the etymology of "embroidery" in closer chronological and genealogical sequence than is followed in the first of his "Cantor lectures,"—[see *Journal* of the 11th inst]—by Mr. Alan S. Cole, C.B.

The word means, in its usage, the adorning of woven stuffs with needlework, in thread of a gold and silver, and variously dyed silk, flax, wool, and cotton; the "ars pingendi" [including the "ars plumaria," "featherwork"] of the Romans, and the *techne poikiltike* [compare "kilting"-work, and "kilt," the "tartan" or Tartareous petticoat, worn by the true Celtic Scots, but usually derived from *kilthe*, "the abdomen," the kilt ornaments rather than covers] of the Greeks, and the *rikhma* of the Semites of Anterior Asia [compare Arabic *rikama* "to write," to "broider"]:—also the broided work itself, the "opus picturatum," "pictura in textili facta," &c., of the Romans, and *poikilma*, and *poikilia* of the Greeks. The art undoubtedly had its origin in Chaldæa, and spread thence by way of Phrygia and Phœnicea into the countries of the Mediterranean sea, whence the Latin phrases "acus Babylonica," "opus Phrygium," &c.

As to the history of the evolution of the word, its oldest verbal forms are broder, and broider, and later embrouden and embroyden, and at last embroid, and embroider, the "er" in embroider being due to the substantival form of the word embroidery, and being as useless as the prefix "em," sometimes written "im," the equivalent of the French "en" and Latin "in." All these forms of the word are derived directly from the French *broider*, in its older form *broder*, and oldest, and only correct form, *border*, [as in *bordeur*], still preserved in the Spanish and Portuguese *bordar* "to broider," its incorrect forms being due to its confusion with "braid" [compare "broided (i.e. plaited) hair," 1 Timothy II.—9], a word of quite another history: and by all the rules of grammar the English verbal form should be [em]-border; and the substantival [em]-bordery; that is the ornamental needlework on the edge, welt, selvage, hem, border, "pretext," fringe, or "limbo" of textile fabrics,—where however the definition of embroidery overlaps lace and fringe, the work of the "limbolarii" of Plautus, in his Aularia, III., 473. But words, like as the flowers, are the daughters of Heaven [compare Sanskrit *vratam* literally "divine ordering," and Vach, the divine Cow, the mother of Speech], and as superior to grammar as was the Emperor Sigismund, and spring up, and live and die as they list:—and it is only Volopukes and Esperantots who imagine they can be artificially machinated.

GEORGE BIRDWOOD.

OBITUARY.

MISS MANNING. — Miss Elizabeth Adelaide Manning, who was the special guide and friend of young Indians who come to England to pursue their studies for the Bar and other professions, succumbed to an illness of some weeks' duration on the 10th inst. Born 77 years ago, she was the daughter of Judge James Manning, the last holder of the office of "Queen's Ancient Serjeant," who was well known in his time, and lived to be 84. Miss Manning was a member of the Society of long standing, having joined in 1875, a few years after she had relieved the celebrated Miss Mary Carpenter of a portion of her benevolent Indian work. Miss Carpenter died in 1877, but six years previously Miss Manning had become the Honorary Secretary of the National Indian Association, a position she continued until shortly before her death to fill with unfailing patience, judgment, and devotion. "Miss Manning's Association," as it has often been called, though much against her wishes, for she was very modest, is perhaps best known for its praiseworthy efforts to promote greater social intercourse between Europeans and Indians. It, however, grew out of Miss Carpenter's zeal for female education, and her successor always seemed to regard this as one of the most if not the most important of the aims of the National Indian Association. She herself contributed largely to its special education funds. In her earlier days she was Secretary of the Froebel Society and helped to establish Girton College, but for a generation India had practically absorbed all her energies. By two or three visits to the East she made herself acquainted at first hand with the educational needs of Indian women, and so highly were her unselfish labours appreciated by those who understood their value that she always could count on the assistance of leading Anglo-Indians. In June, 1904, the King-Emperor conferred upon her the Kaisar-i-Hind Medal, 1st Class, she being the third member of her sex to receive this distinction. The funeral took place on Monday last at Golder's Green Crematorium.

GENERAL NOTES.

MORTMAIN ACT.—In the fourteenth Annual Report of the Board of Trade recently issued under Section 29 of the Companies (Winding-up) Act, 1890, reference is made to an important point in connection with companies registered abroad. Express power is given to companies registered under the Companies Act (other than those not formed for profit) to hold lands in Mortmain, but this privilege does not extend to companies registered abroad, or in the

Colonies, or in Guernsey. Consequently none of these companies have power to hold land except under the authority of an express license from the King, and the Mortmain Act of 1888 provides that if any land is held by a company without a license, it shall be forfeited to His Majesty. The Comptroller of the Companies' Department says that this is an aspect of foreign registrations which has not been hitherto appreciated.

ADULTERATION OF RUBBER.—The director of the Para botanic gardens reports in the bulletin of the Para Museum that it has been recently discovered by a person unconnected with the production of rubber that a latex obtained from a tree, entirely different from the "Heveas," has been employed not only to adulterate rubber but in some cases to replace it altogether. Experienced estate owners, writes Mr. Consul Churchill, in referring to the subject in his report on the trade of Para (No. 3436, Annual Series), believe the substitute to be slightly less elastic than the genuine article. It seems that the great demand has led to the practice of adulteration for some years past. The trees in question are plentiful and exist over a very wide area. They are known in the State of Amazones by the name of "Tapurú," and in the neighbourhood of Para as "Murupita," "Seringa-Rana," &c. Botanists are of opinion that they belong to a species of "Sapuim." The word "Tapurú" is the Indian name for an insect, and is given to the trees because they are frequently destroyed by termites, particularly when tapping has been performed by unskilful hands. The advantages of the "Tapurú" and its congeners consist in their being more plentiful than the "Heveas," and in their more rapid reproduction.

BRITISH CEMENT EXPORTS.—Not many years ago San Francisco took nearly all its cement imports from the United Kingdom, now it takes none. To all intents and purposes it is a lost trade. The following figures give the British imports to San Francisco in the years named:—1902, 4,395,999 lbs.; 1903, 11,353,200 lbs.; 1904, 86,774 lbs. It was simply a question of time as to when imported cement would be entirely supplanted by the domestic article, and although Belgium and Germany still send a good deal of cement to San Francisco their exports last year were considerably less than half those of 1903. The great increase in public works, buildings, &c., in San Francisco has created an enormous demand for cement, but nearly the whole of it is supplied by local manufacturers. It is the same at San Diego. The total imports of 1904 amounted to only £7,704, showing a falling off of £24,064 as compared with the imports of 1903, and whilst £16,173 of the 1903 imports came from the United Kingdom in 1904 it sent none at all, Belgium and Germany supplying all that was imported. The cost of labour and setting up of cement plants has hitherto given the imported article a fair chance in the market, but as the local cement factories increase in efficiency, and permanently have the advantage of a short distance for distribution, the foreign product, more especially having regard to the preferential tariff, must expect to be shut out. California cement is packed in jute sacks which alone must effect a great saving in cost of delivery.

TRADE WITH ERZEROUM.—In his report, dated June 6, 1905 (No. 3442, Annual Series), Mr. Consul Shipley directs attention to the remarkable shrinkage of British exports to Erzeroum. British cotton goods showed a decrease of 25 per cent., as compared with the preceding year, and imports from the United Kingdom of all sorts a shrinkage of 20 per cent., German and Italian goods supplying the deficiency. Between them these two countries imported into Erzeroum for local sale or distribution in the neighbouring provinces, flannelette (called velour calico there) to the value of £100,000, £300,000 being the average total of manufactured goods imported there annually for sale or despatch inland. A few years ago these £300,000 were spent wholly in the United Kingdom. Now, "as a beginning," Germany and Italy have taken a third. It is high time, says Mr. Consul Shipley, that representatives of British firms should pay the district a visit and study the needs of the population. The difficulties of travelling are not so great as they are said to be; the Kurds are usually most hospitable to strangers, and the weather from May to October is generally fine. Mr. Shipley says he receives many trade catalogues in English that are not worth the postage spent on them.

JAPANESE COMPETITION IN CHINESE MARKETS. —The German Consul-General at Shanghai has recently addressed circular letters to German business houses in his district, advising the heads of the various firms to encourage the cultivation of a knowledge of the Chinese language in order to be able to meet Japanese competition, which, he says, after the close of the present war, will extend into western and northern China. The present system of selling goods through the agency of compradores will change, and ere long the trade will have to be carried on by the foreign houses direct. This will necessitate the *employés* of the various firms coming into personal intercourse with the Chinese purchasers, and for that reason a command of the language of the latter is requisite. In short, the Western nations must do as the Japanese do, if they do not want the latter to monopolise the trade. The Consul-General proposes a course of instruction for the German clerks and *employés* in the Chinese language, and offers to place his consulate at their disposal for this purpose, and the assistance of his interpreters. The German Consul-General's admonitions apply with equal force to British interests.

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NOTICES.

SECTIONAL COMMITTEES.

APPLIED ART SECTION COMMITTEE.

The following is the list of the Applied Art Section Committee, as appointed by the Council:—

Sir Owen Roberts, M.A., D.C.L., F.S.A. (Chairman of the Council).
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D. (Chairman of the Committee).
Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.
Thomas Armstrong, C.B.
George Frederick Bodley, R.A.
Prof. A. H. Church, M.A., F.R.S., F.C.S.
Alan S. Cole, C.B.
Sidney Colvin, M.A.
Walter Crane, R.W.S.
Henry Hardinge Cunynghame, C.B.
Cyril Davenport.
Lewis Foreman Day.
Alfred East, A.R.A.
Arthur Evans, F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
J. Starkie Gardner, F.S.A.
William Gowland, F.S.A.
Gerald C. Horsley.
Thomas Graham Jackson, R.A.
Arthur Lasenby Liberty.
Seymour Lucas, R.A.
Sir Edward J. Poynter, Bart., P.R.A.
Sir Walter S. Prideaux.
Halsey Ralph Ricardo.
W. E. Riley.
Alexander Siemens.
A. B. Skinner, B.A., F.S.A.
R. Phené Spiers, F.S.A.
Hugh Stannus, F.R.I.B.A.
H. H. Statham, F.R.I.B.A.
Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S.
Carmichael Thomas.
Sir John I. Thornycroft, LL.D., F.R.S.
Sir Thomas Wardle.
Sir Aston Webb, R.A., F.R.I.B.A., F.S.A.
Henry B. Wheatley, F.S.A. (Secretary).

CASTS.*

It is said of the late Walter Pater that the perfect copy of an ancient coin would give him as much pleasure as the original. To only the few is this power given of discriminating between the abstract and the extrinsic. The judgment of the majority is always largely influenced by accidental values such as antiquity and ownership can impart. If our insight is so clear that we can detach the intrinsic value from its surrounding glamour then a perfect copy will suffice for our edification. But it must be a perfect copy.

If we consider how such a copy can be obtained we shall soon see that no process of reproduction can be quite so perfect as that of casting. Neither can anything be quite so simple. A perfect impression of a coin, for instance, may be obtained in plaster of Paris, or, by the process of electrotyping in metal. The latter is only another form of casting, in which the metal is precipitated in the mould by electricity. While the electrotype is thus able to cast the object in the original medium, gold, silver, or copper, the plaster cast is no less perfect in reproducing the form, and, by departing from the original matter one is able to draw closer to the abstract beauty, to criticise more faithfully; the electrotype must always have some of the glamour of the antique coin itself. In speaking of casts, therefore, I shall take the cast in plaster of Paris as being the most satisfactory and appropriate form of the "perfect copy."

A plaster cast brings all kinds of objects to a common term, to use the language of mathematics; it translates bronze, marble, terra-cotta, ivory, &c., into plaster of Paris, the "universal language" of the plastic arts, we might call it.

Casting may be defined as the process of reproducing objects of three dimensions in three dimensions; a parallel case is offered by photography, which will faithfully reproduce two dimensions in two dimensions—giving "perfect copies" of manuscripts, drawings, &c. Photography will also reproduce three dimensions in two, of course, but that will no longer be a true representation or a parallel case.

A cast serves a double purpose; it often brings out the true value of the original, and multiplications of it enable comparisons to be made in any instance where comparison is necessary.

* Communicated by Mr. Max Judge.

To take the first case: whatever there is in an original object which is not transferred to the cast is parasitic; the original may be valuable for some romantic, perhaps fictitious, mutable reason; the cast is valuable as exhibiting the real value of the original. It will not reproduce ownership, antiquity, vicissitude.

The second case is merely an example of the value of multiplication, and concerns the applicability of casts, resulting from the expedient of obtaining an endless number of facsimiles of any one object.

Let us take the Venus of Milo in the Louvre as one example. A mould once taken, all the museums of the world are enabled to possess a perfect copy of the statue to help to complete their collections. They will have all that they require for intrinsic archæological reasons. There are, of course, extrinsic archæological data which can only be derived from the original, not because it is an original, but because it is the object that has been wrought upon by time and burial. The cast cannot reproduce the texture and the surface of the marble, but it reproduces the Greek conception. This statue, perhaps, is itself only a copy of the original. For a cast cannot alter the original conception of a thing. What is an "original"?—the perpetuation, in some form, of the idea of a master-mind. In the first instance it may have been evolved out of clay, to take its subsequent shape in marble or bronze; and the cast only takes the translation one step further.

The archæologist has not to depend on any one statue for the study of texture and *patina*. There are no collections which cannot include the beauty of the Venus of Milo; and for the form, the technique, the handling of the masses, a cast will serve the student as well as the Louvre original, *à seul* in its velvet-hung *Salon*.

Thus a cast means the facility of spreading abroad what would otherwise exist only in one place. What printing does for literature, photography for painting, casting does for the plastic arts; we should remember that printing is only the result of casting movable type.

We thus come to the employment of casts in the scientific study of archæology. In archæology, no less than in any other science, it is important to assimilate the existing data before any thought is given to projecting new theories and exploring new ground. Research is of no avail if that which has already been discovered is not commanded by the seeker after more truth. Until this is done it is useless trying to follow the results of the latest excavations or to criticise the latest "finds." The archæologist must know the famous collections, and by means of a comprehensive collection of casts he can know them without travelling through Europe from capital to capital. The catalogue of such a collection is the best manual of archæology that a student can study.

Without casts archæology as a science would have made much slower progress and settled into narrower channels. Think of the different statues of antiquity in the different corners of Europe. What *lacunæ*, what a want of relativity would exist in each separate collection if the gaps were not filled by casts! In the ideal collection there would be a strictly chronological order, exhibiting without break the gradual rise and decline of the various schools of the different countries. With casts at command of all, gaps cannot occur. One cannot lament the absence of any famous statue. We need not bemoan the fact that a certain example is in Paris. What does it matter where the original is in keeping—be it London, Paris, Berlin, Dresden, or Munich; as a cast it will fall into its place in this comprehensive collection, with a value unaffected by accidental locality, increasing the value of the collection by its inclusion in its fitting into, so complete a scheme.

If there is not the ideal collection here in mind there are several collections of great value from their comprehensive nature. Those at Berlin (New Museum) and Strassburg (University) come first in importance, and next must be placed the American collection in the Boston Museum of Fine Arts. The catalogue of this last collection is just such a manual as we have suggested as being the best help to the student.

Our own collection at South Kensington is not one that can compare with any of the three mentioned above. London should have its own comprehensive collection. The British Museum may be rich in original marbles, but they will not make up for the want of a distinct, complete collection wherein the comparative study of archæology may be pursued to the full.

Comparisons in archæology are never odious—rather are they essential. Only with casts can comparisons be effected with the fullest advantage. Different examples of the same type, slightly varying copies of a lost original, can thus be set side by side for analysis, and a more faithful synthesis of the original obtained.

In the Elgin marbles at the British Museum the frieze of the Parthenon is made more complete by casts of the sections in other collections and of those few blocks still *in situ* on the temple. Further, there are casts in duplicate of the same pieces, the second taken after an interval of several years, thus showing the result of leaving those precious panels to the mercy of time and weather—and showing too, ill-treatment which can be brought nearer home. The first set of casts, taken before subsequent disfigurement and decay, possesses, therefore, inestimable value; the casts, in fact, become original sources for study, seeing that they embody matter which is now lost in any other form.

In the Boston Museum already mentioned, there is another instance of a cast gaining additional value—becoming individual owing to its possessing some quality no longer the property of the original itself. The museum possesses one of the few casts of the celebrated Portland vase taken before it was shattered. The story of the broken vase is too well

known to need telling. The mould was taken while the vase was still the property of the Barberini family, and destroyed after a few copies had been taken from it in plaster of Paris.

There are other instances of casts having considerable interest and value attached to them—when they become more, in fact, than the "perfect copy" which we started with as the criterion. One is the cast at South Kensington of the Aphrodité of Cnidos. The statue itself, in the Vatican, has the legs and lower part of the body covered up with tin drapery to satisfy the peculiar prudery of the Italian authorities. No photograph has ever been taken of the statue "undraped," but fortunately the tin stuff was allowed to be removed, and a complete cast specially taken for our museum, and all photographs of the unadorned statue are from casts taken from that mould.

Another instance is connected with the famous copy of Myron's Discobolus, supposed to be in the Palazzo Lancellotti, at Rome—supposed to be, because there is very much uncertainty regarding it. The statue has been kept carefully "locked up," and there have even been rumours that it has gone to America. In any case it is not to be seen, and only one photograph of it has been taken. As it is agreed to be the most authentic copy of Myron's work handed down to us, it must be looked upon as a fortunate occurrence for archæologists when someone discovered in Paris a cast of the head of the statue, seeing that the statue itself is practically non-existent.

Curious instances of natural casting, or rather moulding, are to be seen at Pompeii, some of the results of the destruction of the city by Vesuvius. The objects of perishable material, buried in the lava, have decayed, leaving a vacuum, or in other words a mould, from which plaster casts have been obtained. By this resource even casts of human figures have been taken, by which we can judge of the accuracy of the results in other cases, where, for instance, a door has been thus taken in plaster and a reproduction then made in timber, with the original latches and bolts fitted to it. This is one of the most marvellous of the many marvellous secrets of antiquity drawn from Pompeii.

One more valuable application of casts must be noted, their use in connection with photographing the various objects which come into the hands of the archæologist. Photographs of coins and gems especially are always taken from casts, that is if the best results are desired. And in many other cases the cast brings out the *form* in the photograph better than the original would do. If, as we have said, the cast loses the surface and the texture, there is a certain recompense for this in the new light in which we see the form. That is a very interesting question. The perfect work of art may combine form and matter in such a subtle measure that until the matter is changed we may verily miss some of the gradations of the form. True, analysis undoes the unity of the art, but does it not show us a little more how great that art was—that art of Greece? In the unity of a masterpiece we are often unconscious of much which goes to make it what it is.

In conclusion, there is a danger connected with the practice of using casts which must not be overlooked. It is in connection with restored work. On the object itself the restorations are generally quite evident (or in some cases the little piece of the original can be detected) but as soon as the object is cast, unless special measures are taken to indicate the modern portions, the result is a homogeneous mass of plaster. It is of course very important to distinguish the old from the new, and if no such marks are desirable on the object itself, at least the name-label and catalogue should contain a careful statement of the restorations.

THREE SCIENTIFIC CENTENARIES.

In his Presidential Address delivered before the Mathematical and Physical Section of the British Association at Cape Town on the 17th inst., Professor A. R. Forsyth, F.R.S., specially directed attention to three interesting centenaries—1605, 1705, and 1805—

In this Section we are in the unusual position of being able to observe three scientific centenaries in one and the same year. Accordingly I propose to refer to these in turn, and to indicate a few of the events filling the intervals between them; but my outline can be of only the most summary character, for the scientific history is a history of three hundred years, and, if searching enough, it could include the tale of nearly all mathematical and astronomical and physical science.

1605.

It is exactly three hundred years since Bacon published "The Advancement of Learning." His discourse, alike in matter, in thought, in outlook, was in advance of its time, and it exercised no great influence for the years that immediately followed its appearance; yet that appearance is one of the chief events in the origins of modern natural science. Taking all knowledge to be his province, he surveys the whole of learning: he deals with the discredits that then could attach to it; he expounds both the dignity and the influence of its pursuit; and he analyses all learning, whether of things divine or of things human, into its ordered branches. He points out deficiencies and gaps; not a few of his recommendations of studies, at his day remaining untouched, have since become great branches of human thought and human inquiry. But what concerns us most here is his attitude towards natural philosophy, all the more remarkable because of the state of knowledge of that subject in his day, particularly in England. It is true that Gilbert had published his discovery of terrestrial magnetism some five years earlier, a discovery followed only too soon by his death; but that

was the single considerable English achievement in modern science down to Bacon's day.

In order to estimate the significance of Bacon's range of thought let me recite a few facts, as an indication of the extreme tenuity of progressive science in that year (1605). They belong to subsequent years, and may serve to show how restricted were the attainments of the period, and how limited were the means of advance. The telescope and the microscope had not yet been invented. The simple laws of planetary motion were not formulated, for Kepler had them only in the making. Logarithms were yet to be discovered by Napier, and to be calculated by Briggs. Descartes was a boy of nine, and Fermat a boy of only four, so that analytical geometry, the middle-life discovery of both of them, was not yet even a dream for either of them. The Italian mathematicians, of whom Cavalieri is the least forgotten, were developing Greek methods of quadrature by a transformed principle of indivisibles; but the infinitesimal calculus was not really in sight, for Newton and Liebnitz were yet unborn. Years were to elapse before, by the ecclesiastical tyranny over thought, Galileo was forced to make a verbal disavowal of his adhesion to the Copernican system of astronomy, of which he was still to be the protagonist in propounding any reasoned proof. Some mathematics could be had, cumbrous arithmetic and algebra, some geometry lumbering after Euclid, and a little trigonometry; but these were mainly the mathematics of the Renaissance, no very great advance upon the translated work of the Greek and the transmitted work of the Arabs. Even our old friend the binomial theorem, which now is supposed to be the possession of nearly every able schoolboy, remained unknown to professional mathematicians for more than half a century yet to come.

Nor is it merely on the negative side that the times seemed unpropitious for a new departure; the spirit of the age in the positive activities of thought and deed was not more sympathetic. Those were the days when the applications of astronomy had become astrology. Men sought for the elixir of life and pondered over the transmutation of baser metals into gold. Shakespeare not long before had produced his play "As You Like It," where the strange natural history of the toad which,

> "Ugly and venomous,
> Bears yet a precious jewel in his head,"

is made a metaphor to illustrate the sweetening uses of adversity. The stiffened Elizabethan laws against witchcraft were to be sternly administered for many a year to come. It was an age that was pulsating with life and illuminated by fancy, but the life was the life of strong action and the fancy was the fancy of ideal imagination; men did not lend themselves to sustained and abstract thought concerning the nature of the universe. When we contemplate the spirit that such a state of knowledge might foster towards scientific learning, and when we recall the world into which Bacon's treatise was launched, we can well be surprised at his far-reaching views, and we can marvel at his isolated wisdom.

I have implied that Bacon's discourse was in advance of its age, so far as England was concerned. Individuals could make their mark in isolated fashion. Thus Harvey, in his hospital work in London, discovered the circulation of the blood; Napier, away on his Scottish estates, invented logarithms; and Horrocks, in the seclusion of a Lancashire curacy, was the first to observe a transit of Venus. But for more than half a century the growth of physical science was mainly due to workers on the continent of Europe. Galileo was making discoveries in the mechanics of solids and fluids, and, specially, he was building on a firm foundation the fabric of the system of astronomy, hazarded nearly a century before by Copernicus; he still was to furnish, by bitter experience, one of the most striking examples in the history of the world that truth is stronger than dogma. Kepler was gradually elucidating the laws of planetary motion, of which such significant use was made later by Newton; and Descartes, by his creation of analytical geometry, was yet to effect such a constructive revolution in mathematics that he might not unfairly be called the founder of modern mathematics. In England the times were out of scientific joint: the political distractions of the Stuart troubles, and the narrow theological bitterness of the Commonwealth, made a poor atmosphere for the progress of scientific learning, which was confined almost to a faithful few. The fidelity of those few, however, had its reward; it was owing to their steady confidence and to their initiative that the Royal Society of London was founded in 1662 by Charles II. At that epoch, science (to quote the words of a picturesque historian) became the fashion of the day. Great Britain began to contribute at least her fitting share to the growing knowledge of Nature; and her scientific activity in the closing part of the seventeenth century was a realisation, wonderful and practical, of a part of Bacon's dream. Undoubtedly the most striking contribution made in that period is Newton's theory of gravitation, as expounded in his "Principia," published in 1687.

That century also saw the discovery of the fluxional calculus by Newton, and of the differential calculus by Leibnitz. These discoveries provided the material for one of the longest and most deadening controversies as to priority in all the long history of those tediously barren occupations; unfortunately they are dear to minds which cannot understand that a discovery should be used, developed, amplified, but should not be a cause of envy, quarrel, or controversy. Let me say, incidentally, that the controversy had a malign influence upon the study of mathematics as pursued in England.

Also, the undulatory theory of light found its first systematic, if incomplete, exposition in the work of Huyghens before the century was out. But Newton had an emission theory of his own, and so the undu-

latory theory of Huyghens found no favour in England, until rather more than a hundred years later the researches of Thomas Young established it on a firm foundation.

1705.

Having thus noted some part of the stir in scientific life which marked the late years of the seventeenth century, let me pass to the second of our centenaries: it belongs to the name of Edmond Halley. Quite independently of his achievement connected with the year 1705 to which I am about to refer, there are special reasons for honouring Halley's name in this Section at our meeting in South Africa. When a young man of twenty-one he left England for St. Helena, and there, in the years 1676-1678, he laid the foundations of stellar astronomy for the Southern Hemisphere; moreover, in the course of his work he there succeeded in securing the first complete observation of a transit of Mercury. After his return to England, the next few years of his life were spent in laying science under a special debt that can hardly be over-appreciated. He placed himself in personal relation with Newton, propounded to him questions and offered information; and it is now a commonplace statement that Halley's questions and suggestions caused Newton to write the "Principia." More than this, we know that Newton's great treatise saw the light only through Halley's persuasive insistence, through his unwearying diligence in saving Newton all cares and trouble and even pecuniary expense, and through his absolutely self-sacrificing devotion to what he made an unwavering duty at that epoch in his life. Again, he appears to have been the first organiser of a scientific expedition, as distinct from a journey of discovery, towards the Southern Seas; he sailed as far as the fifty-second degree of southern latitude, devised the principle of the sextant in the course of his voyaging, and, as a result of the voyage, he produced a general chart of the Atlantic Ocean, with special reference to the deviation of the compass. Original, touched with genius, cheery of soul, strenuous in thought, and generous by nature, he spent his life in a continuously productive devotion to astronomical science, from boyhood to a span of years far beyond that which satisfied the Psalmist's broodings. I have selected a characteristic incident in his scientific activity, one of the most brilliant (though it cannot be claimed as the most important) of his astronomical achievements; it strikes me as one of the most chivalrously bold acts of convinced science within my knowledge. It is only the story of a comet.

I have just explained, very briefly, Halley's share in the production of Newton's "Principia"; his close concern with it made him the Mahomet of the new dispensation of the astronomical universe, and he was prepared to view all its phenomena in the light of that dispensation. A comet had appeared in 1682—it was still the age when scientific men could think that, by a collision between the earth and a comet, "this most beautiful order of things would be entirely destroyed and reduced to its ancient chaos"; but this fear was taken as a "by-the-bye," which happily interfered with neither observations nor calculations. Observations had duly been made. The data were used to obtain the elements of the orbit, employing Newton's theory as a working hypothesis; and he expresses an incidental regret as to the intrinsic errors of assumed numerical elements, and of recorded observations. It then occurred to Halley to calculate similarly the elements of the comet which Kepler and others had seen in 1607, and of which records had been made; the Newtonian theory gave elements in close accord with those belonging to the comet calculated from the latest observations, though a new regret is expressed that the 1607 observations had not been made with more accuracy. On these results he committed himself (being then a man of forty-nine years of age) to a prophecy (which could not be checked for fifty-three years to come) that the comet would return about the end of the year 1758 or the beginnng of the next succeeding year; he was willing to leave his conclusion "to be discussed by the care of posterity, after the truth is found out by the event." But not completely content with this stage of his work, he obtained with difficulty a book by Apian, giving an account of a comet seen in 1531, and recording a number of observations. Halley, constant to his faith in the Newtonian hypothesis, used that hypothesis to calculate the elements of the orbit of the Apian comet; once more regretting the uncertainty of the data, and discounting a very grievous error committed by Apian himself, Halley concluded that the Apian comet of 1531, and the Kepler comet of 1607, and the observed comet of 1682 were one and the same. He confirmed his prediction as to the date of its return, and he concludes his argument with a blend of confidence and patriotism:—

"Wherefore if according to what we have already said it should return again about the year 1758, candid posterity will not refuse to acknowledge that this was first discovered by an Englishman."

Such was Halley's prediction published in the year 1705. The comet pursued its course, and it was next seen on Christmas Day, 1758. Candid posterity, so far from refusing to acknowledge that the discovery was made by an Englishman, has linked Halley's name with the comet, possibly for all time.

1805.

It is time for me to pass on to third of the centenaries, with which the present year can be associated. Not so fundamental for the initiation of modern science as was the year in which the "Advancement of Learning" was published, not so romantic in the progress of modern science as was the year in which Halley gave his prediction to the world, the year 1805 (turbulent as it was with the

strife of European politics) is marked by the silent voices of a couple of scientific records. In that year Laplace published the last progressive instalment of his great treatise on Celestial Mechanics, the portion that still remained for the future being solely of an historical character; the great number of astronomical phenomena which he had been able to explain by his mathematical presentation of the consequences of the Newtonian theory would, by themselves, have been sufficient to give confidence in the validity of that theory. In that year also Monge published his treatise, classical and still to be read by all students of the subject, "The Application of Algebra to Geometry"; it is the starting point of modern synthetic geometry, which has marched in ample development since his day. These are but landmarks in the history of mathematical science, one of them indicating the completed attainment of a tremendous task, the other of them initiating a new departure; both of them have their significance in the progress of their respective sciences.

When we contemplate the activity and the achievements of the century that has elapsed since the stages which have just been mentioned were attained in mathematical science, the amount, the variety, the progressive diligence, are little less than bewildering. It is not merely the vast development of all the sciences that calls for remark: no less striking is their detailed development. Each branch of science now has an enormous array of workers, a development rendered more easily possible by the growing increase in the number of professional posts; and through the influence of these workers and their labours there is an ever-increasing body of scientific facts. Yet an aggregate of facts is not an explanatory theory any more necessarily than a pile of carefully fashioned stones in a cathedral; and the genius of a Kepler and a Newton is just as absolutely needed to evolve the comprehending theory as the genius of great architects was needed for the Gothic cathedrals of France and of England. Not infrequently it is ifficult to make out what is the main line of progress in any one subject, let alone in a group of subjects; and though illumination comes from striking results that appeal, not merely to the professional workers, but also to unprofessional observers, this illumination is the exception rather than the rule. We can allow, and we should continue to allow, freedom of initiative in all directions. That freedom sometimes means isolation, and its undue exercise can lead to narrowness of view. In spite of the complex ramification of the sciences which it has fostered, it is a safer and a wiser spirit than that of uncongenial compulsion, which can be as dogmatic in matters scientific as it can be in matters theological. Owing to the varieties of mind, whether in individuals or in races, the progress of thought and the growth of knowledge are not ultimately governed by the wishes of any individual or the prejudices of any section of individuals. Here, a school of growing thought may be ignored; there, it may be denounced as of no importance; somewhere else, it may be politely persecuted out of possible existence. But the here, and the there, and the somewhere else do not make up the universe of human activity; and that school, like Galileo's earth in defiance of all dogmatic authority, still will move.

JAPANESE PAPER.

Japanese paper—by which is meant only paper made from the bark of plants indigenous to Japan, with a slight admixture, in certain cases, of other materials—being of a special character, is little exported. The export to China is the only one of any importance. In addition, a certain number of napkins, and thin copying papers, are exported to America, and an attempt to put notepaper on the foreign market has met with some success. In Japan itself, paper is used as a substitute for many articles, and foreign doctors there have largely adopted the use of thin papers for bandages. The striking point in the manufacture of Japanese paper is the absence of machinery. Everything is done by manual labour. Factories are almost unknown, the industry being carried on in a small way by each family separately. Except where the members of a family are insufficient there is no hired labour, and consequently paper-making families are less affected by the rise and fall in prices which follows the variation in the demand. Lately, one or two paper mills have been erected, notably in Osaka and Oji, a suburb of Tokio, but these are almost entirely engaged in making foreign paper. Such conditions are not conducive to progress, and until recently Japanese paper-making stood just where it was 500 years ago. Lately, however, much has been done to improve matters by the establishment of guilds. These look after the interests of their members and ensure them a market for their goods. At the same time, the guilds have teachers in their employ who point out to the paper-makers their mistakes. These guilds met with a good deal of opposition at first from the peasants, who did not always see the advantage of making good paper, instead of adulterating it with earth, and thus cheapening the cost of production.

In a report dated Tokio, May 1905 (No. 635, Miscellaneous Series), Mr. Oswald White, Student-Interpreter in the British Consular Service in Japan, gives an interesting account of Japanese paper-making. Japanese paper is made principally from the bark of three trees, the kozu or kaji (paper Mulberry, *Broussonetia papyrifera*); mitsumata (*Edgeworthia papyrifera*), and the gampi (*humanire Wickstrœmia Canescens*). Of these by far the most important are the first two, the latter being only used in making gampishi or koppi, copying paper. Formerly the amount of kozu used was far greater than that of mitsumata, but of late years the latter has been coming much more into use. The kozu is

grown in the fields generally between rows of mugi (wheat, barley) or of other plants, or along the borders. It needs a dry position fairly sheltered from the wind, which tears the bark, and open to the sun's rays. It is propagated by means of thin shoots from the root. These are taken off in November, buried in the ground in bundles, and planted out in April. By December the plant grows to a height of about 2½ feet, and is then cut down to within an inch of the ground. The following year there will be two or three stems, the next five or six, and so on. Every year it is cut down close to the ground in December. On an average a plant is good only for 15 or 16 years, as after that time the fibre becomes too tough. Owing to the fact that the harvest is in December, paper-making was formerly largely—and is still, to some extent—carried on by farmers as a temporary occupation in the winter when agriculture is impossible. The mitsumata is grown on the sloping ground in a position where it can receive a good supply of moisture. It must be sheltered to some extent from the sun, and altogether is a less hardy plant than the kozu. Propagation was formerly conducted as with kozu, but is now done by means of seed, which is much quicker. The seeds are sown in spring, 20 or 30 together. After a year the young plants are taken up and planted separately. Every year each stem puts forth three branches, thus giving rise to the name, viz, three forks—mitsu-mata. By the end of three or four years from planting the stem attains a thickness of about an inch, and is then cut down close to the ground. This takes place in April. Three, or, if necessary, four years are allowed to elapse before it is cut again; but after that the plant can be cut every year, though it is not used for more than about ten years altogether. The gampi is a bush growing wild on the mountains, and sought during the summer. Where possible it is pulled up by the roots. By this means several of the roots are broken off and left behind in the soil. These grow up again in three or four years. When the bush is too big to be pulled up it is cut down. Kishiu produces a great part of the supply of gampi.

The stems of the kozu and mitsumata from which the bark is to be removed are first cut into lengths of about 3 feet and then steamed for two or three hours. The top of the small furnace used has a cup-shaped cavity in the centre, containing water. Above this is placed a layer of two or three inches of straw, on which rests a barrel upside down containing the kozu or mitsumata. The object of the straw is to prevent any escape of the steam. After two or three hours steaming the bark becomes loosened and can be stripped off by the hand. The inner bark is then separated from the outer. In this operation the bark is first cleansed in water and the epidermis is then scraped off with a knife leaving the white inner bark. In the case of the kozu a good deal of the green part of the bark does not come off at first. This, when scraped off, forms the kasu used in chirigami. In the case of the gampi the bark separates naturally from the trunk without steaming. The epidermis and inner bark also separate naturally, but a good deal of the green part remains, which must be separated with a knife. The bark thus obtained is washed, dried, and then brought to market. Osaka forms the chief market for bark.

Japanese paper may be divided into the following classes:—(1) That made only from kozu; (2) from kozu or mitsumata, or from a mixture of the two; (3) from gampi; (4) from kasu, waste paper, &c. The only papers which are not now made from mitsumata as well as from kozu are those where great strength is necessary. One of the strongest of these papers is yoshino-gami (filter paper). It is also the thinnest—6,000 sheets when placed together only reach a height of about 13 inches. Its chief use is in filtering lacquer, several sheets being placed together for the purpose. As it does not tear the same paper may be used several times. Tengu-jo is a very similar paper, though slightly thicker and stronger. Like yoshino-gami, it is much used in felting. Another use is for pasting on glass windows with which shoji are sometimes made, a variety with designs being much employed. Japanese paper, being for the most part unsized, is of a very porous nature. The cement used mainly serves to bind the fibres together, and does not fill up the interstices as the sizing in foreign paper. This fits it very well, for the Japanese brush and ink which it absorbs. For the same reason it is impossible to write on proper Japanese paper with a pen. When a paper is required that can be written on with a pen, a sizing in which resin forms a principal part is used. Japanese paper is distinct from foreign paper in another way, its strength does not arise from any felting or intertwisting of the fibres, but from their length and tough nature. In papers of medium thickness the fibres lie in one direction only, while in thick papers the fibres lie in two directions at right angles. Thick paper is almost impossible to tear. Other paper, if made with a due regard to strength, will only tear in one direction, *i.e.*, parallel to the fibres. The strength of Japanese papers, not being assisted by any felting of the fibres, is not proof against wet, which dissolves the cement holding them together. The Japanese oil-paper, however, is excellently adapted for withstanding moisture. Another disadvantage of Japanese paper is that, owing to its porous nature, it is very liable to the attack of insects. But this may be guarded against by putting between the sheets certain leaves the smell of which the insects dislike.

In order to produce designs in the paper a silk gauze is used. The designs are drawn on paper, cut out and sewn on. The gauze is then laid on the scoop net, and the paper made in the usual way. The paper is thin in the parts corresponding to the designs on the gauze, thus reproducing them. Silk gauze without designs is also used in making the finest papers. To prevent the silk from rotting it

has to be dried every five or six days and painted with shibu (the astringent juice of the unripe kaki or persimmon). In Kochi, instead of silk gauze being used, the net is made of brass, and the designs sewn on it of copper. The objection to this method is that only thick paper can be made by it. The pile of newly-made paper is next pressed clear of liquid, and then the sheets are separated one by one, and spread out with a smooth brush on planks, which are dried in the sun. The sheets are then detached, and nothing remains to be done but to cut them to a uniform size. When, however, it is required to give a gloss to the paper one or two sheets are placed within thin plates of zinc and passed between rollers. As the sheets are dried in the open air the rainy season is the worst for the ordinary paper-maker. The pile may be left for a week or ten days without separating the sheets, but if left longer the colour of the paper changes. For this reason the few larger establishments have apparatus for drying the paper by steam where necessary. It is found that where paper is thus artificially dried the colour is not so good but the paper becomes stronger than if dried in the sun.

TRADE WITHIN THE EMPIRE.

The Annual Statement of the trade of the United Kingdom with foreign countries and British possessions in 1904, was issued last week. The figures relating to the trade between Great Britain, India, and the Colonies indicate expansion which in certain products has been large. One of the most striking evidences of this expansion is afforded by the fruit industry. Beginning with Canada, the import into the United Kingdom of raw apples has risen from 803,638 cwts., of the value of £427,763, in 1900, to 1,208,409 cwts., valued at £619,844, in 1904. The import of raw pears, and fruit preserved with or without sugar other than dried, also shows considerable increase. The increase in apples from Australia is comparatively much larger, although the total import is still only about a quarter of that from Canada. In 1900 87,748 cwts. of apples, valued at £113,445, came to the United Kingdom from Australia; in 1904 the weight had increased to 333,959 cwts., and the value to £336,781. Oranges, on the other hand, show a falling off from 1,519 cwts., valued at £1,460, to 996 cwts., of the value of £756 only. The figures for the West Indies show how rapidly the orange trade has developed in those islands. Below are the numbers imported in each of the last five years:—1900, 7,390 cwts.; 1901, 27,109 cwts.; 1902, 44,529 cwts.; 1903, 63,834 cwts.; 1904, 94,350 cwts. But the shrinkage in the banana trade is striking. The following figures give the number of bunches imported in each of the five years:—1900, 1,337; 1901, 547,043; 1902, 967,405; 1903, 682,883; 1904, 476,868. In 1904 the imports of bananas were less than half those of 1902.

Eminent authorities differ as to whether Canada is likely to very largely increase her corn exports to the United Kingdom. The land is there in abundance but some think the United States may soon take all Canada's surplus. Be that as it may the present growth of the Canadian exports of wheat to the United Kingdom is not very rapid as the following figures show:— 1900, 6,337,600 cwts.; 1903, 10,802,12[illegible] cwts.; 1904, 6,195,300 cwts. Wheatmeal and flour have increased from 1,195,219 cwts. in 1900 to 2,045,767 cwts. in 1904, but the imports last year were half a million cwts. less than in 1903, whilst the imports of barley, oats, rye, peas, and maize were very much less in 1904 than in 1900, maize dropping from 4,795,400 cwts. in 1900 to 1,872,700 in 1904. The wheat imports from Australia vary greatly. In 1900 they were 2,651,600 cwts., in 1903, owing to the drought, they had fallen to 26 cwts., in 1904 they reached 10,272,600 cwts. Wheatmeal and flour imports show similar variation. The meat imports have fallen away in a very remarkable way, if rabbits are excepted:—

	1900.	1902.	1904.
	cwts.	cwts.	cwts.
Beef (fresh)	413,991	65,860	76,345
Mutton (fresh)	446,049	270,134	163,014
Rabbits (dead	210,822	106,974	322,853

The meat imports from Canada are small if bacon is excepted, the import of which has increased from 529,864 cwts. in 1900 to 829,883 in 1904. Eggs have fallen from 807,702, "great hundreds," in 1900, to 317,722 in 1904, but cheese shows steady increase, from 1,511,872 cwts. in 1900 to 1,900,556 cwts. in 1904, and butter from 138,313 cwts. in the former year to 268,607 in the latter.

Perhaps the most remarkable figures in these food statistics are those which relate to the importation of wheat from British India. They are as follows:— 1900, 6,100 cwts.; 1901, 3,341,500 cwts.; 1902, 8,841 586 cwts.; 1903, 17,057,857 cwts.; 1904, 25,493,000 cwts.

The following figures give the value of the imports and exports from India and the leading colonies in 1900 and 1904:—

	Imports.		Exports.	
	1900.	1904.	1900.	1904.
	£	£	£	£
India	27,388,106	36,472,636	30,966,938	41,544,4[illegible]
Canada	21,764,021	22,621,164	7,605,257	10,024,221
Australia	23,800,820	23,568,918	21,575,828	17,336,47[illegible]
Cape of Good Hope	3,637,497	4,933,489	9,336,711	12,048,7[illegible]
West India Islands	1,670,206	1,895,212	1,771,860	2,024,3[illegible]

It will be seen that whilst the growth of our trade with India during the period under review was very large, with the greater colonies it has been more moderate, whilst the exports from Australia show a heavy shrinkage.

THE FUTURE OF THE CHINESE SILK TRADE.

The future of the silk trade of China merits the most careful consideration, not only of silk producers and manufacturers, but also of all those who are interested in the export and import trade, to and from, the Far East. Forty years ago, silk constituted 24 per cent. of the total exports of the Chinese Empire; in 1904 it represented 33 per cent., yet, in many resspects, the trade was unsatisfactory. In spite of favourable conditions abroad, Chinese silk, it is said, is beginning to lose its hold on the world's markets, but it is hardly likely that this will continue indefinitely, for with modern methods, China will again resume her old predominance in the silk trade. The silk production of China does not depend upon conditions and rules obtaining in other countries, and although, according to a recent report of the United States Consul at Amoy, many mistakes are being made in the methods of silk production, China can, and does, produce silk more cheaply and more extensively, counting its home consumption, than any other nation, by the sheer force of her position. The favourable climate and cheap labour make it possible for China to continue in the silk field, when, by every law of modern business, its ancient methods and continued bad management ought to have thrown it out of the struggle long ago. If China can continue to grow silk with bad management and without modern scientific methods, the world can surely appreciate the fact that, with the improved methods which are certain to come, even if they come slowly, which, in fact, are already being employed in some cases, will come such a volume of raw silk products as will give a new and permanent turn to the silk business of the world.

In China there is a vast population familiar with silkworm culture. A slight increase in the margin of profit to the producer will mean immensely increased production. Already the production is large. Ten of the eighteen provinces of China produce silk, although at present most of the Chinese silk is produced at Chekiang, Kiangsi, and Kwangtung. Take, for example, the Chekiang province, having a total area of 98,700 square miles; the total value of its annual production of cocoons is estimated by an expert at £500,000, or more than the total production of Fukushima, Shinshu, and Bushu provinces in Japan. At present, the best Chinese cocoons are the cheapest cocoons in the world, and yet, the Consul says, so far as the cost of labour and material is concerned, the cost of the production of silk may be further reduced and will indefinitely remain below the cost of production in Japan, not to mention America or Europe. As between the two nations in the Far East which produce silk, manufacturers should devote the closest attention to China. The silk industry of Japan is highly developed; it represents science and the most progressive business methods. The Japanese silkworm is not hatched unless the egg containing it has passed scientific examination. Nothing is left to chance. The mulberry leaves on which the worms feed, are grown upon trees scientifically cared for and protected from disease and pests. There is no loss in the growth of the trees, the hatching of the eggs, or the feeding of worms which do not produce. In China very much is left to chance, because the fathers of the present producers did not know any other methods than those now adopted. While the mulberry trees are cared for carefully in some cases, are fertilised and cultivated and stripped of their leaves in the autumn to give them a longer rest in the short winter, there is no protection for them from worms and other pests. The ravages of caterpillars and animal life generally are not prevented, while the average Chinese mulberry grove produces less than two-thirds of a crop of leaves as compared with other countries, and especially as compared with what is produced in China itself where the circumstances are more favourable. The treatment of the silkworms is of a similar character. The disease of the average silkworm stock in China is such that there is a constant and immense loss in worm food for which there is no return. It is estimated by a reliable authority that not more than 700 out of 1,000 eggs will develop worms to live through the several stages, and of these 700 not more than 400 will spin cocoons of any practical use, the other 300 having consumed food to no useful purpose. Such methods as are now employed in China in fact are cutting down the product of a mulberry tree fully one-half, and inasmuch as the groves themselves are more or less diseased there is further loss in this respect. With the acreage in mulberry groves now existing, and the trees and worms cared for on a scientific basis, the silk product of the Chinese Empire ought to be fully double what it is. Indeed it is difficult to appreciate the vast increase in silk production in China which will follow the introduction of scientific methods of culture. In spite of all this loss and these drawbacks, which would in time ruin the silk industry if not corrected, the first grade raw silk product of China is better than similar grades in Japan, and probably than in any other country. The Chinese silkworm naturally produces the largest quantity of the finest silk of any silkworm in any country. If the export of Chinese white silk has fallen off, as compared with that of Japan, it is due altogether to a failure to meet promptly the exigencies of the moment and to introduce modern scientific methods. The Chinese cocoon, especially cocoons from Chekiang and the northern provinces, is round or egg-shaped, bright in colour, with fine fibre, few joints, and a strong thread.

Some time ago an official of the Commercial and Agricultural Department of Tokyo, made a comparative investigation of the Japanese and Chinese cocoons and reported the following average quality of their production:—Japanese, good cocoons, 82·57 per cent.; double cocoons, 10·65; and waste cocoons, 6·78; total, 100. Chinese, good cocoons, 83·36; double cocoons, 8·62; waste cocoons, 2·90; cover cocoons, 5·12 per cent.; total, 100. It was

further shown that in length and quality of silk the Japanese cocoons are apparently superior to the Chinese, but in the fineness and uniformity of fibre the Chinese cocoons are superior to the Japanese. The test of strength was in the proportion of 59 for the Chinese and 45 for the Japanese fibre. In colour, in ease of manipulation, and in other respects, the Chinese cocoon leads. Having the advantage of a lower cost of production and natural superiority, Chinese silk production needs only the introduction of modern scientific methods in the culture and care of the mulberry trees, in the examination and sorting of silkworms' eggs, and in the care of the cocoons, to control the silk situation, not only in the Far East, but probably in the world at large. Chinese silk merchants still have an idea that they can, and do, fix silk prices for all markets. As a matter of fact, however, they can now do nothing of the kind. It is shown in the annual report for 1904 of the Chinese Imperial Maritime Customs, that "of the world's supply of silk, at present based upon the average of the past three years—1902 to 1904—and not including the home weaving of China and Japan, China provides 27 per cent. (North China 18 and South China 9), Japan 28 per cent., Italy 25 per cent., and all other countries 20 per cent." Yet if China produces 27 per cent. under present conditions, what it can and will produce under scientific treatment ought to be apparent to the silk world. It once took from 400 to 500 pounds of cocoons to make a picul (133 pounds) of silk. It now takes from 500 to 800 pounds. When the former figures are not only reached, but are bettered, China's real position in the silk industry of the world will be realised. The opinion of the Consul is, that because Chinese silk cocoons have been deteriorating on an average for some time, any expectation that the Chinese silk industry is disappearing or will disappear is a mistake. The silk business of the world is hardly in a position to do without one-third of its supply of raw material, hence pressure abroad will probably force the reform which the Chinese have been slow to make, but which, sooner or later, must come. At present raw material supplies must come from the cheap labour countries of the Far East—from China and Japan. For European and American manufacturers also it is to be considered that Japan is soon to be, if it is not already such, a competitor in the manufacture of those silk products which have heretofore been regarded as the peculiar product of European and American looms. In Japan the silk industry is commencing to change from an enterprise in which silk is produced from the mulberry tree and silkworm and incidentally manufactured into goods to an enterprise where raw materials from abroad are manufactured to suit the world's market. The importations of raw silk products from China into Japan are increasing yearly, and, with the passing of the war in which Japan is now engaged, it is only reasonable to assume that it will increase far more, marking what probably is a permanent change in the silk industry of Japan. This is to be the case not only because Japan is becoming more and more a manufacturing country, but also because Chinese raw silk is by nature better than Japanese raw silk, and can be produced more cheaply. It is not to be expected that there will be much, if any, change for the better in the silk situation of China until that change comes through action or demand from abroad.

There are several reasons for this, one of them being a lack of large amounts of ready capital and the unwillingness of Chinese people with sufficient capital to invest it at the present time. Another reason is, that while there are millions of people in China more or less well versed in the production of silk upon the present basis, there are very few who understand marketing their product, and these few are generally the middle-men, who are now making most of the money in the business. Probably the strongest deterrent factor, however, is the ever-baneful influence of monetary exchange, both international and that among the provinces and the several districts. The former two unfavourable elements could, and would be eliminated by foreigners doing business in China on behalf of foreign silk industries, and apparently there is no reason why much of the trouble from exchange could not be eliminated by a concern which is in business both in China and abroad. The Chinese themselves are paying considerable attention to the situation, and probably will invest more money in modern plants than they have ever invested before. One indication of this is in the increase in the number of factories for drying cocoons. If the price of silk continues as at present, if the silkworms are properly cared for, and if improved apparatus is imported, Chinese silk will, it is said, supplant all foreign raw silk, including Japanese, in the markets of the world. It is significant that, notwithstanding the fact that the price of silk has risen about 30 per cent. in the past few years, and apparatus for drying, steaming, and every other process has been greatly improved, the condition of Japanese factories is reported to be worse year by year. In Japan, this is attributed to two causes:—(1) Too many factories in proportion to the amount of cocoons produced, thus raising the price of materials by increased demand; (2) general rise in the cost of labour and everything, largely increasing the cost of production. The fact is that raw silk can be produced more cheaply elsewhere than in Japan, and the Japanese tariff is keeping out much of this material that the factories need. Already Chinese silk is finding its way into Japan, however, and the amount will increase as the price of Japanese silk for home consumption advances, and as Japanese silk manufacturers continue to go abroad for raw materials. The importation of wild cocoon silk by Japan during the past three years, may be regarded as a sign of the coming tide. There is now among Japanese manufacturers a growing appreciation of the importance of possessing factories in China for the purpose of controlling the business. If this, says the

Consul, is true of Japanese manufacturers, it certainly behoves European and American silk manufacturers to take action in the same direction. Europe and America will certainly continue to lead in the beauty and variety of their silk manufactures, but Asia will grow their raw materials.

EXPERIMENTAL COTTON PLANTING IN JAVA.

During 1903 a small quantity of prime Egyptian cotton seed was imported by the Mercantile Society of Amsterdam and planted on an estate situated on the high lands near Malang, East Java. On the advice of an authority on cotton cultivation, the seeds were planted, three grains per hole, at a distance of six inches apart. This distance, however, seemed to be too great. The soil was kept clean and free of weeds, and in a short time the seeds sprouted. When the plants began to bear leaves, they were transplanted. The plants developed well, and the average yield per plant may be considered very satisfactory, but when the crop was gathered in October, some eight or nine months after planting, it was found that 2,000 plants to the "bahoe" (1·75 acres) was not sufficient. The average yield was one picul (136 pounds) of clean cotton, and about two piculs (272 pounds) of seed to the "bahoe" (1·75 acres). On another estate near Malang, the yield has been somewhat better—204 pounds of clean cotton, and 408 pounds of seed to the "bahoe." The cotton has been cleaned by a patent hand machine with a capacity of from 4·2 to 5·5 pounds of clean cotton an hour. The quality of the cotton is as good as could be desired, the staple being fine and long, and shipments have already been made to the Netherlands. According to the American Consul at Batavia, the native cotton, "Kapasdjawa," is shipped almost exclusively to Eastern parts as raw cotton not cleaned from seeds. It has a very short staple, and is, therefore, unfit for weaving yarn, and its value is therefore slight. It is chiefly used for upholstering purposes. Under the most favourable circumstances it would never pay a European to cultivate this native cotton, the yield being valued at about £3 per acre per annum. The European planters therefore decided to experiment with other varieties, hoping that their efforts might in the end prove successful. In 1904 a further experiment was made in cotton, and although it has not yet been reported on, it is expected to be far more successful than the experiments in 1903. The soil has been well worked, and a more intensive mode of cultivation has been adopted than in the previous year. February is considered in Java the best time for sowing the seed, and October and November are generally the months for gathering the crop. The young plants have the benefit of the rain, and the crop is gathered before the next rains begin, which is absolutely necessary, as the buds are destroyed by heavy rains. In addition to the common hand gin used in 1903, a patent self-feeding double-action cotton gin has been ordered for working the 1904 crop. This gin can turn out forty pounds an hour, and is of one and a half horse-power. Some little trouble is experienced from caterpillars, especially in a wet season, but during the usual dry season, expected from the end of March to the latter part of October, there is not much difficulty in guarding against this pest, although this means constant watching. It has been ascertained that the cotton plants do not thrive well in a moist soil, and do not grow so well in virgin soil as in soil which has been planted for a season or more. It appears that the Netherlands Indian Government has, for a number of years, endeavoured to encourage the natives in different districts of Java in the cultivation of long-stapled cotton, but without success. Dr. Tromp de Haas, formerly connected with the botanical gardens of Buitenzorg, has written articles on the cultivation of cotton in Java in which he states that unfavourable weather and plagues are responsible for its want of success. Others, however, believe it is only a question of time when cotton will be successfully grown in Java. A firm of well-known spinners in Gronau has taken on trial a quantity of the Java cotton, and is quoted as reporting on it as follows:—"The Java cotton taken in hand is of splendid quality, and in colour especially is not to be distinguished from the Delta product. The staple is pretty equal, and the yarn may be used for numbers 40, 45, and, at the utmost, 50, and for exceptionally fine qualities. Planting this sort of cotton might prove remunerative. The samples sent have not been combed, though they look as if they had been." In addition to a few small trials made with imported Sea Island seed during the past year, experiments were to be made near Malang, and the following varieties were imported for planting:—Mit afifi, Abassi, and Yanovitch from Egypt; and Sea Island, Shine Upland, and King Upland from the United States. The first four are of long staple, and the last two of average staple. These were planted in a tract of about 70 acres, and the seed soon sprouted and produced healthy plants. When the first buds appeared the plants were in fine condition, and the most hopeful anticipations of good results were entertained if the rains would only cease. The rains, however, did not cease, and consequently what had been fine flourishing plants were stripped of their buds, and nothing but the bare stalks were left. Some plants attempted to bud again, but were attacked by small beetles, and in time they all died.

THE BRAZILIAN FIBRE INDUSTRY.

According to a recent report from Bahia, great progress has been made in the development of "caroa," the plant from which the natives obtain

the fibre employed in the construction of the ropes which bind the packages of tobacco sent to Bahia. Experiments were undertaken by an enterprising British syndicate in 1902, but good samples of sufficient bulk for ascertaining the commercial value of the fibre were only available for export in the autumn of 1903. These samples came from the Queimadas district; and although the machinery employed was rather primitive, excellent results were obtained. H.M. Consul at Bahia says it is certain that, with the experience already gained and the new and specially-constructed machinery, higher qualities of fibre will shortly be available and ropes produced which will rival the best Manilla. Experiments were commenced with sundry fibrous plants which abound in the whole district, but "carao" proving the most important and abundant, all other varieties were for the moment neglected. The natives extract the fibre by retting the long leaves for some fifteen or sixteen days, and then, fermentation having set in, the fibre is easily extracted. Another process employed is to break the ribbons with stones in order to remove the pectose or gummy matter. It is claimed that by these primitive methods a clever worker can obtain some ten pounds in a day. Much time is consumed in the operation of gathering the leaves—which usually measure from six to nine feet—owing to the strong, short thorns along their edges. Proper machinery obviates many of the difficulties of preparation, but it is not thought that any machine can be employed for the gathering of the leaf, owing to the dense nature of the bush. The crop is gathered by men who protect the palms of the hands with a strong pad of leather, a skilful man being able to pull one ton of leaves in five or six days. The breaking strain of some caroa ropes shown to the Consul was three tons to the square inch. For twine, the breaking strain was 135 lbs., and for yarn 200 lbs. to the square inch.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in May and June last:—

New Charts.—No. 3497—England, east coast:—Hull road. 3498—Sweden, east coast:—Stockholm Skärgärd. 3501—Baltic; Gulf of Bothnia:—Approaches to Nystad (plans:—Fairway near Iso-Varestus. Anch. on W.C. of Lökö island). 3503—Germany, north coast:—Gulf of Danzig, western part. 92—Spain, south-west coast:—Cape St. Vincent to strait of Gibraltar. 2822—France, south coast:—Gulfs of Napoule and Juan, including Cannes and Antibes. 3496—Greece, west coast:—Scropha point to Cape Kamilafka. 3483—Black Sea:—Cape Lukul to Cape Meganom. 3502—West Indies; Puerto Rico:—Guanica harbour. 3495—West Indies, Leeward islands; Bieques or Crab island:—Port Mulas and approaches. 136—Bay of Bengal:—River Húgli—Saugor point to Calcutta. 3481—Bay of Bengal:—Moulmein river to Yé river. 3489—Bay of Bengal; Tenasserim:—Hinzé basin. 3504—Indian Ocean; Christmas island:—Flying Fish cove. 3440—Eastern archipelago:—Plans of anchorages between Celebes and New Guinea. 3487—Philippine islands; Luzon island:—Manila and Kavite anchorages. 3039—Arctic sea; Novaya Zemlya; plan added:—Lyamchina bay. 2221—Black Sea; plans of Russian ports on the north shore; new plan:—Mzuimta road. 3411—Africa, west coast; Garraway anchorage; plans added:—Rocktown Berebi anchorage; Grand Berebi anchorage; Sassandra anchorage; Port Bouet. 219—Malacca strait; Acheh head to Diamond point; plan added:—Lampujang strait. 2201—Sumatra; plans in; new plan:—Simalur island or Pulo Babi. 928—Borneo island; Sulu archipelago; new plan:—Maibun anchorage. 2196—Celebes; sketch plans of anchorages in southern part; plan added:—Bintaru anchorage. 3274—China; Yangtse kiang river:—Tungting lake and Siang river. Shanic Kan; Liu cha po; Chang sa. 836—Japan; Amakusa islands and Yatsushiro sea; plan added:—Kuro seto.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

No. 3291—Germany; Elbe river, outer light vessel to Brunsbüttelkoog. 1479—Norway; the Naze to the North cape. 2306—Norway; Sheet IV.; Romsdals islands to Hitteren island. 3435—Plans on the east coast of Sweden. 2300—Baltic; gulf of Bothnia; Sheet V.:—Stiernö point to Fiäderäg, &c. 2247—Gulf of Finland; Hogland to Seskär, north shore. 798—France; west coast:—Douarnenez bay and approach. 1755—Spain; north coast:—San Ciprian bay to Cape Finisterre. 2235—Black Sea; Sheet IV.:—Fort Anakria to Kertch strait. 577—British Columbia; inner channels leading from Juan de Fuca strait to Haro strait. 395—Africa; west coast:—Isles do Los, &c. 1174—Africa; west coast:—Bonny, New Calabar, and Sombrero rivers. 641—Africa; south coast:—Port Elizabeth. 143—Red Sea:—Jebel Tier to Perim island. 901—Red Sea; Sawákin harbour. 1884—Bay of Bengal; Arakan river, Akyab. 2104—Eastern archipelago; Borneo island; Sheet I.:—South Natuna islands. 2987—Philippine islands; San Pedro to Libukan islands. 1742—China, Canton river; Sheet IV.:—Second bar pagoda to Whampoa, &c. 1739—China; Canton river; Sheet V.:—Whampoa channel and Chang shan island to Canton. 1601—China; north-east coast:—Wusung river. 61—Japan; Harbours and anchorages on the north-west coast of Nipon. 3109—Japan; Yokohama bay. 2294—Pacific; Sandwich islands:—Pearl river and lochs.

HOME INDUSTRIES.

Printers and Country Towns.—There is a growing tendency in certain trades to move from London to the country. This is particularly noticeable with the printing trade. Taking only towns within easy distance of the metropolis, it will be found that some of the largest London printing houses have branches at St. Alban's, Dunstable, Dorking, Redhill, Guildford, Reading, Swindon, Tonbridge. What may be called "rush" work must always, so far as it applies to London, be done in London, the time taken up in transit being fatal to country competition; but for all other kinds of work the small country town, well placed as to railway communication, offers many advantages. Rent is from 25 to 50 per cent. less, wages from 20 to 25 per cent. lower. The work is done in healthier surroundings, and there is less friction with the workmen, who are drawn from all parts of the country. Many—perhaps most—of them have London experience, but the managers of the works prefer countrymen to Londoners born, and have no difficulty in getting them. What the transference of a large printing business means to one of these small towns may be gathered from a single illustration. This one has a population of about 12,000, and until a few years ago its tradesmen had to cater only for the very moderate wants of a stagnant country town. Then two great printing firms set up works in the place, and now the wages bill of one of them is close upon £300 per week. Of this probably £250—or something like £13,000 a year—is spent in the town. And the money distributed in the form of wages by the other firm—an important one—must be large. It is, of course, only certain trades that have freedom of choice as to where they will have their works, but where there is such choice there is much in favour of the country site.

Rating of Machinery.—A League has recently been formed having for its object a clear definition of the existing law as regards the liability of machinery in the nature of personal property to be rated, or brought into account for rating purposes, with a view to establishing its exemption from such liability. In the final report of the Commissioners on Local Taxation (Cd. 638, 1901), reference was made to this question of the rating of machinery, and the Commissioners gave expression to the following emphatic opinion:—"It is beyond controversy that in any amendment to the existing law the main object to be arrived at must be the removal of all uncertainty as to what kinds of machinery are, and what are not, to be taken into account in estimating the rateable value of factories." The Commissioners recommended that "in estimating the rateable value of any hereditament occupied for trade, business, or manufacturing purposes there shall be excluded from the assessment any increased value arising from machines, tools, or appliances which are not fixed, or are only so fixed that they can be removed from their place without necessitating the removal of any part of the hereditament. But the value of any machinery, machine, or plant used in or on the hereditament for producing or transmitting such motive power, or for heating or lighting the hereditament shall be included." The present uncertainty as to the law, and the varying practice of rating authorities, are the chief points of complaint. In the City they only partially rate machinery. In Westminster they do not rate it at all. Elsewhere they are rating it at 10 per cent. of its capital value, which means, upon £1,000 of machinery, with rates at, say, 7s. in the £, an addition of from £30 to £40 per annum to the rates paid.

The Law as to Rating Machinery.—Up to the passing of the temporary Poor-rate Exemption Act of 1840, personal property which was local, visible, and productive, including stock-in-trade and all machinery whether physically made part of the manufactory in which it was found or not, was rateable according to the law. As a matter of fact, however, such machinery was not rated, though the practice in this respect varied in different localities. Stock-in-trade was still in law a subject of assessment, and to remove the grievance the Act of 1840 was passed. This Act, which has been kept in force by the Expiring Laws Continuance Acts, provided that "it shall not be lawful for the overseers of any parish, township, or village to tax any inhabitant thereof, as such inhabitant, in respect of his liability derived from the profits of stock-in-trade, or any other property for or towards the relief of the poor." Since the passing of the Act, machinery has not been rateable *per se*. On the other hand it has been decided that in valuing buildings (such as factories), certain kinds of machinery are to be taken into account in ascertaining the rateable value of the premises. What are the kinds of machinery that are to be taken into account in ascertaining the rateable value of a factory? According to Mathew, J. (now L. J.), whose language was adopted by the Court of Appeal, "the machinery ought to be taken into account as essentially necessary to the business to which the premises are devoted and manifestly intended to remain connected with the premises so long as they are used for the same purpose." Under the law as it now stands, as was pointed out by the Commissioners, the line between the kinds of machinery which are, and those which are not, to be taken into account in ascertaining the rateable value of a factory, is one that it is practically impossible to draw with any approach to distinctness. The result of this uncertainty as to what machines are, and are not to be taken into account in ascertaining the rateable value of the factory in which these machines stand is that a great divergence of practice exists among the rating authorities in different districts, and a large amount of dissatisfaction prevails among manufacturers in regard to the matter, "a matter," to quote the Commissioners, "that deeply affects the interests of some of the most important industries in the country."

Crops Without Stock.—The late Mr. Prout sought to solve the problem of feeding corn crops directly with suitable artificial fertilisers, and of cutting out the intermediary link of live stock as a means of manuring the land. This system of consecutive corn growing has now been carried out at the farm at Sawbridgeworth for forty years without a break, and in a letter to the present writer, Mr. W. A. Prout gives the result—"Wheat 35 bushels per acre, the average of the last 25 years. Under ordinary treatment the average for England is 28 bushels. From the year 1865 to 1879 the crops were sold standing, by auction, just before harvest, so during that period I cannot give you the yield per acre, as the purchasers never told me. Since 1880 the crops have been harvested in the usual way, and an annual sale of hay and straw held generally in April." As to the soil, Mr. Prout goes on to say, "The soil was analysed in 1865, 1877, and 1903, and the result was to show no exhaustion, but on the contrary it was richer in several ingredients in 1877 and 1903." It is not only with wheat that Mr. Prout's system has succeeded. Taking the years between 1880 and 1904, his wheat crops as stated have averaged 35 bushels per acre, his barley 39 bushels, and his oats 52 bushels. Adding the straw, which is also sold, the total returns from the three cereals have averaged, wheat £9 8s. 9d. per acre, barley £7 13s. 10d. per acre, oats £7 5s. 6d. per acre.

Cocoa.—The growth of the demand for cocoa in the United Kingdom in recent years has been remarkable. Taking the last fifteen years, it will be found that in 1890 the quantity of raw cocoa retained for home consumption was 20,225,349 lbs., in 1904 it had risen to 45,234,210 lbs.; and the total of cocoa or chocolate ground, prepared, or in any way manufactured, had increased from 2,141,786 lbs. to 10,052,247 lbs. Taking the quantities per head of the population the increase in the consumption of raw cocoa over the same period was from 0·54 lbs. to 1·06 lbs., and of preparation of cocoa and chocolate from 0·06 lbs. to 0·23 lbs. Trinidad continues to be in the forefront as a producer. The value of the island's export of cocoa increased from £500,000 in 1894, to £907,000 in 1902-3. The growth of cacao enabled Trinidad and Grenada to recover prosperity which had been lost by the fall in the price of sugar, but they will have to reckon with serious competition from other countries. Foreign Governments have recently sent experts to Trinidad to study the growth and preparation of cacao and the area of cultivation may be expected to increase rapidly. Already considerable quantities are exported from the Gold Coast and Egypt which possess a flavour preferred by the market for some purposes. The profit made by the cacao grower is very considerable, prices being well maintained, and the profit of the home retailer is also known to be large, so that there is plenty of room for competition to bring about a considerable fall in prices. The use of artificial drying is extending and its superiority to sun drying, both as regards quality and cost, appears to be demonstrated. Not much progress has been made in the study of the fermentation of cacao. Good results are now produced by purely empirical methods. The manuring of cacao trees has received some attention, and lime in various forms has been tried with beneficial results, but beyond this little has been done with artificial manures.

Colonial Exhibits at the Crystal Palace.—The exhibition of colonial products now open at the Crystal Palace can hardly fail to be of service to the Colonies and the United Kingdom, by making the public here better acquainted with the character of colonial exports. Not the least interesting section of the exhibition is that covered by the West India islands. As readers of the *Journal* know, many of the islands are turning to what used to be known as "mixed cultivation" to give them the profit they can no longer confidently reckon upon from the sugar plantations. Jamaica led the way with the export of bananas and oranges, and now other islands are following suit. None is better fitted by soil and climate to be a large exporter of fruit than Trinidad. The natural conditions there, including rainfall, all favour profitable banana growing, and Trinidad is not liable to hurricanes like the one that swept the standing crops to the ground in Jamaica in 1903. In many parts of Trinidad bananas thrive in a practically wild state, and the Royal Mail Steamship Company is about to make arrangements which will greatly facilitate the transport of the fruit to England. But there is a curious difficulty in the way of fruit culture for export in Trinidad. It is the large profit accruing from cocoa cultivation. Nothing pays like it, and from the big employer of labour to the time-expired coolie with his one acre of land, all cultivate cocoa wherever the land available is suitable for it.

Profits of Banana Growing.—Nevertheless the profits of banana growing are substantial. Some months ago, Mr. W. E. Smith, the general manager of the Trinidad Railway, was sent by the Agricultural Society of Trinidad to inquire into and report upon the methods of handling, transporting, and shipment of bananas and oranges in Jamaica, and in his report he gives some figures as to profits which are interesting. He took an estate of 300 acres, of cultivated cane land principally, which had been in cultivation about three years. The cost of clearing and preparing the land—ploughing, planting, weeding, and pruning—was a little over the average of £10 per acre. The initial expenses were fully realised with the first fruiting, after which the net clearance each year amounted to not less than £10 per acre. This is typical of many estates, both where irrigation is carried on and otherwise. An acre of bananas planted, say 14 ft. by 12 feet, will give roughly, 250 plants, or three stems to each stock. Under good tillage, and with average luck, these

should produce not less than 300 bunches annually, extending over the ratooning period, which varies from three to six years. To be on the safe side, take 260 full paying bunches, which realise an average price of 1s. 6d. The gross revenue comes to £19 10s., and after deducting say 45 per cent. for general management, including propping the fruit stems, reaping, carting, and interest on capital, the net clearance is not less than £10 per acre. One hundred acres of bananas in full bearing, under average conditions of soil, cultivation, and rainfall, would therefore mean an income of £1.000 a year. Mr. Smith, who is in charge of the Trinidad Section of the Exhibition at the Crystal Palace, says he should be inclined to say that these figures, which applied to last year, should now be reduced by 25 per cent. owing to the reduction in prices consequent upon the monopoly that has been established. But even if this reduction be made, a profit of £7 10s. per acre is a very handsome one.

CORRESPONDENCE.

THE NEW TRADE MARKS ACT.

The Trade Marks Act, which was passed last session and comes into operation next year, will make a new and most useful era in commercial legislation.

One of the first points which arrest attention is the sensible definition of a trade mark :—"It shall mean a mark used or proposed to be used upon or in connection with goods for the purpose of indicating that they are the goods of the proprietor of such trade mark by virtue of manufacture, selection, certification, dealing with, or offering for sale." Hitherto it was necessary to use a trade mark on the goods or on the bottle containing them. Under the new law it may be used in connection with goods—that is, by show-cards, posters on the hoardings, circulars, or by advertisements. Such pictorial embellishments are largely employed to attract public attention and to indicate various goods. The registered proprietor may be anyone practically who handles the goods. Hitherto trade marks have been held exclusively by manufacturers and merchants. Now the buyer who selects and the expert who certifies the goods may each register his brand.

The Comptroller-General of Patents, Designs and Trade Marks is appointed the Registrar of Trade Marks, and in any proceedings before him has power, with the consent of the parties, to require the attendance of witnesses, take evidence on oath, award costs, and be in the same position in all respects as an official referee of the Supreme Court.

What is a registrable trade mark has always been a vexed question and a fruitful source of litigation. Section 9 enlarges the scope of registration as follows :—

A registrable trade mark must contain or consist of at least one of the following essential particulars :—

(1) The name of a company, individual, or firm represented in a special or particular manner; (2) the signature of the applicant for registration, or some predecessor in his business; (3) an invented word or invented words; (4) a word or words having no direct reference to the character or quality of the goods, and not being, according to its ordinary signification, a geographical name or a surname; (5) any other distinctive mark, but a name, signature, or word or words, other than such as fall within the descriptions in the above paragraphs (1), (2), (3), and (4), shall not, except by order of the Board of Trade or the Court, be deemed a distinctive mark: provided always that any special or distinctive word or words, letter, numeral, or combination of letters or numerals used as a trade mark by the applicant or his predecessors in business before the 13th day of August, 1875, which has continued to be used (either in its original form or with additions or alterations not substantially affecting the identity of the same) down to the date of the application for registration shall be registrable as a trade mark under this Act. For the purposes of this section 'distinctive' shall mean adapted to distinguish the goods of the proprietor of the trade mark from those of other persons. In determining whether a trade mark is so adapted, the tribunal may, in the case of a trade mark in actual use, take into consideration the extent to which such user has rendered such trade mark in fact distinctive for the goods with respect to which it is registered or proposed to be registered."

A company will now, for the first time, be allowed to register its name if represented in a special or particular manner. This is an improvement on "particular and distinctive manner" in the present Act. The registration of the signature of the applicant's predecessor is also a useful innovation, as it enables a joint stock company to register its founder's signature as a new mark. Words having indirect reference to the character or quality of the goods will now be registered. This would appear to cover "Electric" velveteen ribbons, "Tower" tea, "Beatrice" shoes, and similar names which have been held not to be fancy words. Geographical names and surnames also, which have been excluded under the present law, will now be registrable, if their ordinary signification is not a geographical name or a surname. Hitherto many good trade marks have been refused registration because they were found among the names in the gazetteers and directories which include "Abbey," "Brook," "Palmer," "Silver," and "Golden," among thousands of common names.

Any other distinctive mark can be registered. This is very broad, as, under Section 3, a mark includes a device, brand, heading, label, ticket, name, signature, word, letter, numeral or any combination thereof.

The registration of associated trade marks is another important and useful provision. It enables an applicant to register the essential features of a label as

separate trade marks, and the user of the whole label shall be deemed to be a user of such separate trade marks.

A new feature is contained in Section 41, which enacts that registration shall, after seven years, be taken to be valid in all respects, unless obtained by fraud or calculated to deceive, or contrary to law and morality.

No proceedings to prevent infringement or recover damages in respect of an unregistered trade mark can be instituted, unless the mark was in use before August 13th, 1875, and has been refused registration under the new Act.

REGINALD W. BARKER.

Vulcan-house, 56, Ludgate-hill, London, E.C., August 22nd, 1905.

OBITUARY.

EARL OF ROMNEY.—Charles 4th Earl of Romney, who died on the 21st inst. at Gressenhall-house, East Dereham, the residence of his daughter, had been a member of the Society of Arts since 1880. He was great-great-grandson of Robert 2nd Lord Romney, the second President of the Society (1761-1794). The second Baron's sister married Jacob Viscount Folkestone, who was the first President of the Society (1755-61). Lord Romney was born on March 7th, 1841, educated at Eton and Christ Church, Oxford. He was J.P. and D.L. for Kent, and J.P. for Norfolk. He took a great interst in the mercantile marine and held the office of President of the Marine Society. Lord Romney was directly descended from Admiral Sir Cloudesley Shovell, whose eldest daughter and coheir married the first Baron Romney.

GENERAL NOTES.

BIRTHS, MARRIAGES, DEATHS.—The returns just issued show the births in England and Wales continue to grow less in proportion to population. For the second quarter in 1905 they were in the proportion of 27·8 annually per 1,000 of the population, the lowest birth-rate recorded in any second quarter since civil registration was established. The mean rate in the ten preceding second quarters was 29·4. In London the rate was 27·0, and, low as it is, it is higher than that of most continental capitals. There are no returns from Moscow or St. Petersburgh, but the annual rate per 1,000 in Hamburg was 26·2, in Berlin 23·3, in Amsterdam 26·0, in Antwerp 25·0, in Buda-Pesth 25·9, in Venice 23·2, in Brussels 19·5, in Paris 18·9 It was higher in Vienna, but only a fraction—27·6. And so with the death-rate, London compares favourably with other capitals, the annual rate per 1,000 being 14·3, as against 17·3 in Paris, 28·1 in St. Petersburgh, 32·0 in Moscow, 17 2 in Berlin, 20·9 in Vienna, 18·6 in New York. Moreover, if all the deaths of non-Londoners that occurred in hospitals and public institutions in London be excluded, the death-rate will not exceed 13·8 per 1,000. Taking the whole of England and Wales, the proportion is only 14·4, the mean rate of the ten preceding second quarters being 16·2. The figures hardly bear out the general opinion that life is much longer in the country than in towns. In 76 great towns, each with a population exceeding 50,000, the death-rate was 14·7 per 1,000; in 141 smaller towns, with populations ranging from 20.000 to 50,000, it was 13·6; in the remainder of the country, with an aggregate population of 13,750,000, of these more than 7,500,000 live in rural districts, the death-rate was 14·5.

MEAT AND FISH IN GERMANY.—What may be called the meat famine in Germany is likely to have a very appreciable effect upon the demand for fish, which fluctuates very largely in that country. In the winter months the consumption is considerable, but it falls off immediately after Easter, and remains small throughout the summer. There is at present, writes Mr. Vice-Consul Oliver, in his Report on German Sea Fishing, Trade, and Industry (No. 636, Miscellaneous Series) no question of fish becoming a staple article of food for the masses of the inland population, but active steps are being taken to popularise the use of it. In view, however, of the present high price of meat—and under the new German tariff which will come into force in 1906, the price of meat, the Vice-Consul thinks, may be appreciably higher—there is a strong probability that the consumption of fish will materially increase. The present duty on meat is:—For fresh and frozen meat, 15s. per cwt.; for salt meat, 17s. 6d. per cwt.; for smoked meat, £1 17s. 6d. per cwt.; and for lard, 9s. 9d. per cwt. Under the new tariff the duty will be £1 2s. 6d., £1 10s. 3d., and 15s. per cwt. respectively.

CURACOA.—Mr. Jacob Jasuram, His Britannic Majesty's Consul at Curaçoa, reporting on the trade and commerce of Curaçoa for 1904 (No. 3428, Annual Series) thinks that an "enterprising promoter might find it possible to form a company to build a dock, as the island's importance will be immeasurably increased"—as soon as the Isthmian Canal is built. Mr. Jasuram also thinks that anyone willing to establish electric, steam, or automobile tramway service, and fulfil Government requirements, will meet with no competitor "if arrangements can be entered into with the proprietor of the present line of tramcars, drawn by mules, who will be unable to retain the new concession if he fails to adapt the present antiquated service to steam, or to solve some other modern mode of conveyance."

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NOTICES.

CANTOR LECTURES ON INTERNAL COMBUSTION ENGINES.

Mr. Dugald Clerk's Cantor Lectures on "Internal Combustion Engines" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C. A full list of the Cantor Lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

USES OF ELECTRICITY IN MINES.

By Henry Willock Ravenshaw,
Assoc.Mem.Inst.C.E., Mem.Fed.Inst M.E.

Lecture I.—Delivered May 15, 1905.

When your Council honoured me with an invitation to give a series of Cantor Lectures on the Uses of Electricity in Mines, I thought that I appreciated the extent of the task I was asked to undertake. I very soon found, however, that the subject is of such a wide character, that, to do ample justice in every direction, would require a great many more than the two lectures that I have undertaken to deliver.

In these lectures, therefore, I propose to confine myself within certain limits. On the one hand, I do not propose to go into the theory of the electrical transmission of power. The use of electricity is now so extensive, and the electric motor is so generally employed, that I feel safe in assuming that my audience has an elementary knowledge of the subject. On the other hand, time will not allow me to go very far into the mechanical side of the question.

Having set certain limits to my subject, I propose to describe as far as possible the various applications of electricity in general use in mines and to give you some data that have been obtained from actual practice.

I find that to the average Londoner, a coal mine is represented by a deep hole, at the bottom of which grimy men dig out the coal under dangerous and uncomfortable conditions, and that there is a general feeling of surprise when I describe the discipline and the wonderful machinery that is to be found underground.

Some idea, however, may be obtained of the magnitude of the work done, when I say that a large colliery may have an output of over 2,500 tons a day, representing six or seven of the immense coal trains that we constantly see on our main lines, and that in some cases, the whole of this coal is brought up one shaft 500 yards deep in 10 or 12 hours.

Taking an average thickness of seam of four feet, this represents an area of an acre and a-half of coal removed per week, or say 75 acres per annum. The result of so large an output is, that the distance from the shaft to the coal face (the place where the coal is actually obtained), becomes greater every year, and in many mines the coal has to be hauled, underground, at least a mile before it reaches the shaft.

To obtain these vast outputs, machinery has to be used wherever possible, and a large amount of power is required both underground and on the surface. Although power is sometimes produced in the mine by means of steam boilers and oil engines. it is usual to generate it on the surface and to carry it down the shaft by one of the following methods:—Steam is carried down in pipes; compressed air is carried down in pipes; continuous ropes are carried down from an engine on the surface; spear rods are alternately raised and lowered to pump water; electricity is carried down through insulated conductors.

To the average engineer the idea of a steam

pipe 400 yards long, is out of the question, yet, in a great many collieries there are pipes of that length carried down deep shafts to supply haulage engines. It is usual for steam to be turned on in these pipes night and day as the joints would be broken if the pipes were allowed to cool down. The loss from condensation is enormous.

Compressed Air is very largely used, and although the losses in the pipes are not so great as where steam is employed, the practical impossibility of warming the air before it reaches the engines, prevents a satisfactory economy from being obtained. Electrical transmission presents many advantages for this class of work, as the efficiency of transmission is high, the cables are easily carried down the shaft, and through roadways, and the motors have been brought to such a state of perfection that breakdowns are infrequent. It is, of course, understood that where there is electrical energy there is some chance of a spark being obtained that would ignite inflammable gas. Large numbers of motors are, however, in use in fiery collieries, and where adequate precautions are taken there is little or no danger. This is borne out by the fact that there are hardly any cases on record where a serious fire or an explosion has been traced to the use of electricity.

I propose to take each application of electrical driving separately, and to give you in some cases actual load curves that have been taken from the machines themselves. The following Table shows the various classes of machinery that are in general use, with the type of load and the range of sizes that are usually met with.

	Usual Sizes.	Type of Load.
Winding	50 to 2,000 B.H.P.	Intermittent with frequent short stops.
Single rope haulage	5 to 200 B.H.P.	Intermittent with long stops.
Continuous haulage	15 to 500 B.H.P.	Steady load.
Main and tail haulage	15 to 100 B.H.P.	Intermittent with fairly long stops
Locomotives	15 to 100 B.H.P.	Intermittent with variable stops.
Creepers	10 to 30 B.H.P.	Continuous variable load.
Coal cutters	20 to 50 B.H.P.	Intermittent with variable stops.
Pumping	5 to 500 B.H.P.	Steady load.
Air compressors	20 to 100 B.H.P.	Intermittent.
Fans	20 to 200 B.H.P.	Steady.
Screens	20 to 50 B.H.P.	Steady load.
Coal washing	20 to 100 B.H.P.	Fairly steady.
Stamps	15 to 100 B.H.P.	Steady.
Crushers	20 to 100 B.H.P.	Very variable.

Winding.—Steam-engines are at present almost universally used for winding, many of them being of large size, and capable of raising heavy loads at a high speed. The character of the load requires rapid acceleration and retardation with extreme accuracy of control. The importance of accurate control is shown in a diagram that I will presently explain, where an engine raises nearly 5 tons of coal in 42 seconds, from a depth of 541 yards. The load attains a speed of 45 miles an hour, and yet it only takes 12 seconds to bring it from full speed to rest. This is done 500 times a day all the year round with a remarkable freedom from accident.

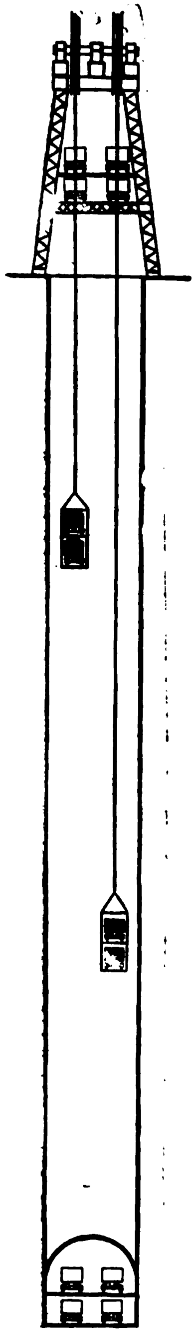
Some electrically driven winding engines of large size have been erected on the Continent, and are giving satisfaction; a good many are also being erected in this country. For small pits and staples (shafts connecting one underground level with another) electrical winding engines have been in use for a good many years, and I know of one which was put down in 1891, and has been in use ever since. Owing to the large amount of power required, and the extreme variations of the demand, the large electrical winding engine presents one of the most difficult problems that the electrical engineer had to deal with.

The problem is that the engine has to start a heavy weight of say five tons, from rest, raise it 500 yards in forty seconds, stop for fifteen seconds, and repeat the operation in the reverse direction. This means that the engine must give an enormous starting effort, and develop from 1,500 to 2,000 horse-power for thirty seconds. It must also be capable of absorbing a large proportion of the energy that has been put into the load so as to enable an accurate stop to be made at the end of its travel. It must be remembered that the moving parts are of great weight, and move at a high velocity, thereby increasing the difficulties in acceleration and retardation. This subject has been discussed to some extent by the members of the Institute of Mining Engineers and other societies, but I do not think that any diagrams have been published showing the actual work done by really large engines.

Where rapid and economical winding is necessary, it is important that the load should be as uniform as possible and this requirement is not obtained when the cages are unbalanced.

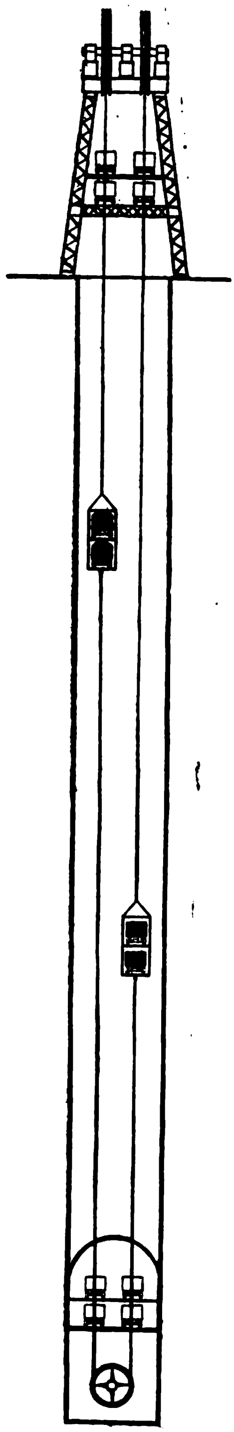
Fig. 1 shows the ordinary unbalanced system where the two cages are suspended from the same drum, one falling and the other rising. Owing to the great weight of the

FIG. 1.



ROPES UNBALANCED.

FIG. 2.



ROPES BALANCED.

rope the load on the engine is constantly varying; for instance, the unbalanced load at starting is the weight of coal to be raised plus the weight of rope. When the cages are passing the ropes balance each other, and the load unbalanced is equal to the coal being raised. Towards the end of the wind the weight of the descending rope predominates and actually overbalances the weight of coal. To give an instance in a particular case, the coal weighed three tons and the rope four tons. As a result the load against the engine at starting was seven tons, at the middle of the wind three tons, and at the end of the wind an overbalance of one ton was tending to drive the engine. This means an extremely variable load and a tendency to run away at the end of the wind.

A number of different methods have been employed for giving a better balance, and to illustrate my point I have shown on Fig. 2 a method which has many advantages, namely a balance rope. This, you will see, consists of a rope passing round a pulley at the bottom of the shaft and one end fastened to each cage. By this method the weight of the rope is balanced and the load is constant, namely, the coal to be raised.

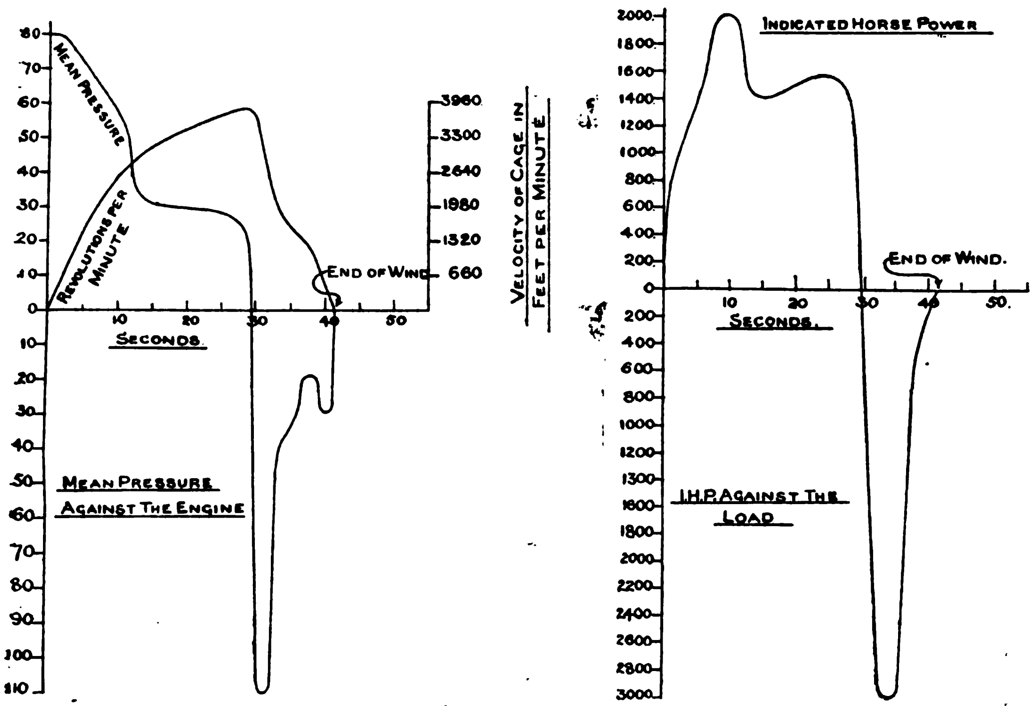
By the use of a heavy balance rope the stresses due to inertia can also be partly balanced. This method of balancing is frequently used in this country, and it is doubtful if really fast winding can be economically carried out without this or some similar arrangement.

I have designed an apparatus for taking continuous records, and have shewn on Figs. 3 and 4 the result of tests taken from two large steam winding engines of modern design under actual working conditions. The engines are of very similar size, but in one case the weight of the ropes is balanced, and in the other it is unbalanced.

Fig. 3 shews that with the balanced arrangement a much higher rate of acceleration is obtained, steam is on the pistons for two-thirds of the running time, and the cages are very promptly brought to rest. In the unbalanced arrangement although the maximum horse-power developed per ton of coal raised is greater, the speed of wind is less, the acceleration and retardation are less rapid and steam is only applied to the pistons for one-half of the running time. It is an interesting fact that in neither case were the brakes used for retarding, and the large amount of energy required to stop should be noted. The peculiar shape of the power curve is due to the fact that in each case when the engine attained a speed of about 40 revolutions per minute an automatic cut off came into play. To illustrate the tremendous variations of load on the cylinders I would point out that in Fig. 3 steam was admitted during the whole of the stroke for six revolutions, it was cut off at one-fourth of the stroke for 14 revolutions, and the valves were reversed with steam against the load for five revolutions. The engine was moving again in the opposite direction in 12 seconds from the time it came to rest.

Although these diagrams do not bear directly on the question of electric driving, they are of the greatest importance as shewing the kind of load that must be dealt with if rapid winding has to be carried out electrically. It will be seen that to apply electrical driving to so variable a load presents considerable difficulties, and that if the demand on the supply is to be free from sudden fluctuations, some method must be adopted for storing up energy during the period of no load. Accumulators can of course be used, but the heavy first cost and upkeep are unfavourable to their general adoption. For small plants it is probable that a motor having the speed regulated between say a third and full speed by means of shunt resistance would give a simple solution, in conjunction with a motor carrying a heavy flywheel running free and connected across the mains. For large plants a more elaborate system has in some cases been adopted. The most characteristic of these is that adopted by Messrs. Siemens and Halske, and known as the Ilgner system. (Fig. 5.) This system includes a Ward Leonard motor transformer, consisting of a motor connected across the source of supply; this machine drives a very heavy flywheel and also a continuous current separately excited generator. The winding motor is also separately excited, and any speed can be obtained up to the maximum by varying the strength of fields of the two latter machines. This arrangement gives very accurate regulation, and has the advantage that the winding motor circuit need never be broken and that a considerable part of the energy given off during retardation is given back into the flywheel. The flywheel used in this system is very heavy, and running at a high speed, stores up a large amount of energy which can be given off as required by automatically causing the speed of the primary motor to be varied. A good many plants on this system are in

FIG. 3.

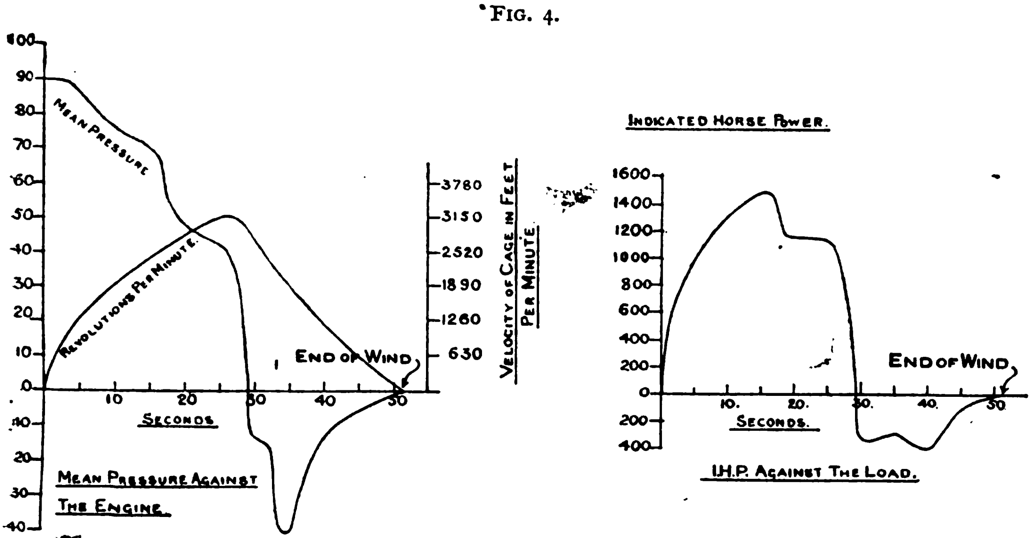


WINDING ENGINE WITH ROPES BALANCED

RESULTS OBTAINED FROM TIME-PRESSURE DIAGRAM

TAKEN APRIL 7th 1905 WEIGH OF COAL RAISED 4 TON, 15 CWT.

FIG. 4.



WINDING ENGINE WITH ROPES UNBALANCED.

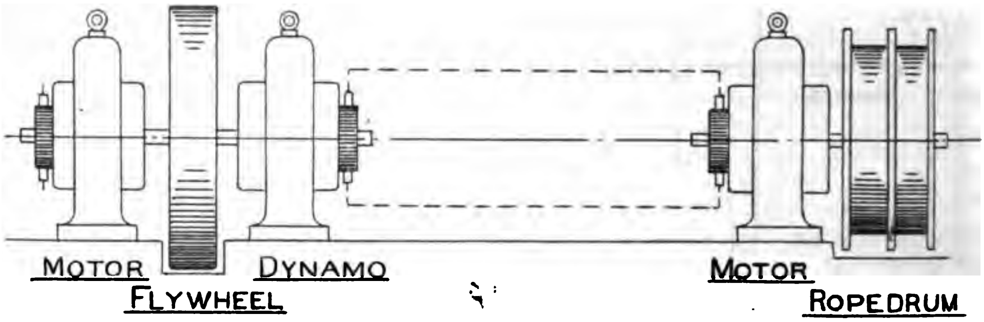
RESULTS OBTAINED FROM TIME-PRESSURE DIAGRAM

TAKEN APRIL 7th 1905 WEIGHT OF COAL RAISED 3 TONS.

successful use on the Continent, and several are under construction in this country.

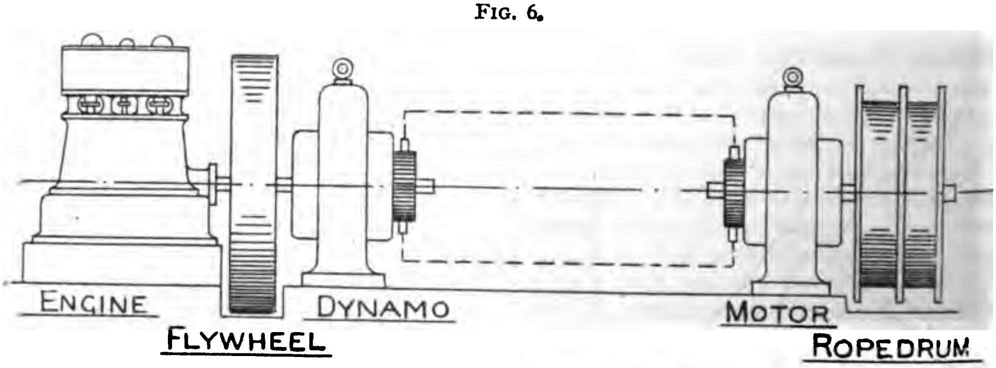
Heavy steel flywheels are used running at a very high peripheral speed, and the result of a burst wheel or a broken shaft might be extremely disastrous. It is of the utmost importance that they should not be placed in the winding engine room, and that they should be so arranged that, in case of accident, the damage would be localised.

FIG. 5.



Mr. Georgi has advocated a simple arrangement in which a high speed steam or gas engine is employed driving a heavy flywheel and a separately excited dynamo. The dynamo would be connected electrically to the separately excited winding motor, and the speed controlled as in the Ward Leonard arrangement. (Fig. 6.)

FIG. 6.



At first sight this appears to be a useless complication, but given highly efficient steam or gas engines there is a great deal to be said for the arrangement. With the advent of the steam turbine, and the still more economical gas engine producing electrical energy at a cheap rate, it is safe to prophecy that in the near future electrical winding will be very largely adopted. The following particulars of electrical winding plants, which are working in Germany, are of interest:—Zollern II. Colliery (Siemens and Halske Ilgner system).—Supply 520 volts direct current. Flywheel 12½ feet diameter; weight 45 tons; maximum peripheral speed 13,600 feet per minute; revolutions per minute 300 to 345. The motor generator takes 600 amperes to start, and after ten minutes takes 100 amperes light. When winding, the primary current varies between 250 and 450 amperes. Five tons of coal are raised per wind, the lift of 330 yards being made in forty-three seconds; the maximum speed is 1,980 feet per minute. The periods of rest are as long as forty-five seconds against twelve to fifteen seconds occupied in some of our best collieries.

At the Preussen II. Colliery there is a large winding engine driven by a three-phase motor. Pressure about 2,300 volts, 25 cycles per second. No arrangement is fitted for storing energy between the winds. Three tons of coal are raised per wind, the lift of 600 yards being made at an average speed of 1,800 feet per minute. The maximum speed is 3,200 feet per minute. This is a successful plant, but there have been difficulties owing to the low power

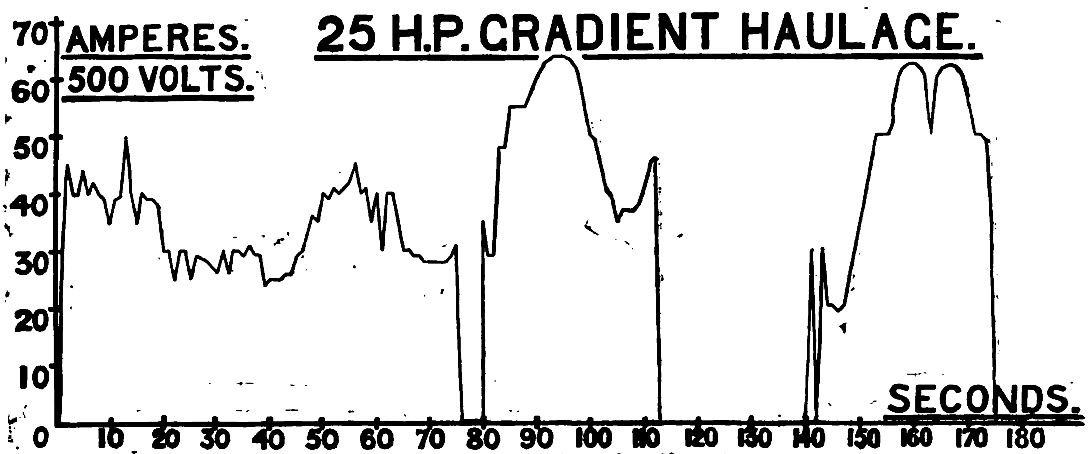
factor of the motor at starting causing great variations of supply pressure.

Underground Haulage. — Underground haulage comes next in importance to winding, as with modern developments of large collieries the coal has very often to be hauled underground for a distance of two or even three miles. In this country most of the coal seams lie on a slope, and consequently, although the coal that is obtained from the higher level will descend by gravity to the bottom of the shaft, the remainder has either to be brought along the level or up hill. Wire rope haulage is almost always employed.

Where the slope is not less than 1 in 20 the empty corves will descend taking the rope with them and either single or double roads are attached to each end of the train, and it can be hauled in either direction. In this case the motor does not usually reverse, two drums being fitted connected to the shaft by clutches. The motor generally starts with the load, and owing to the trains having to be hauled in both directions, the demand for current occurs twice as frequently as with the single rope haulage. Continuous rope haulage is very largely adopted and has many advantages. There are two roads, main and return, and the corves are either attached to the rope singly or in sets, the speed being about four miles per hour. The advantages of this system are regular supply, slow speed, and consequently fewer accidents.

The load on the motor is an excellent one,

Fig. 7.



employed. In the case of double road haulage the system is very similar to that adopted in winding, and the load is of the same character. With a single rope the motor runs in one direction, as, in lowering, the drum is let free, the empty corves unwinding the rope as they run down the incline. The load on the motor is consequently intermittent, the motor not being in use for more than half the time.

Fig. 7 shows a load curve taken from a 25 horse-power single rope haulage motor from which you will see that there were excessive variations of load owing to curves and steep places on the incline. This demand on the supply was repeated every half hour.

Where the roads are flat or undulating, main and tail haulage is frequently used, a second rope being carried on pulleys to the end of the roadway, round a large pulley, and back to the tail end of the train. There is therefore a rope as the demand is usually practically constant while the motor is running. Fig. 8 shows a record taken from a 25 horse-power single rope haulage plant, which is only intermittently used, there being 20 runs of about five minutes duration in eight hours. Where several roads are served, and separate ropes used for each road, all the rope pulleys are driven from one motor, and the demand is remarkably steady. I have frequently seen the ammeter connected to a 200 horse-power motor remain steady to within 5 per cent. for long periods. Some very large continuous haulage motors are at work in this country.

Electric Locomotives are very little used in this country, the only one with which I am acquainted being in the Greenside Mines, under Helvellyn, in Westmorland. In the United States they are largely used, the coal being more free from faults than in this

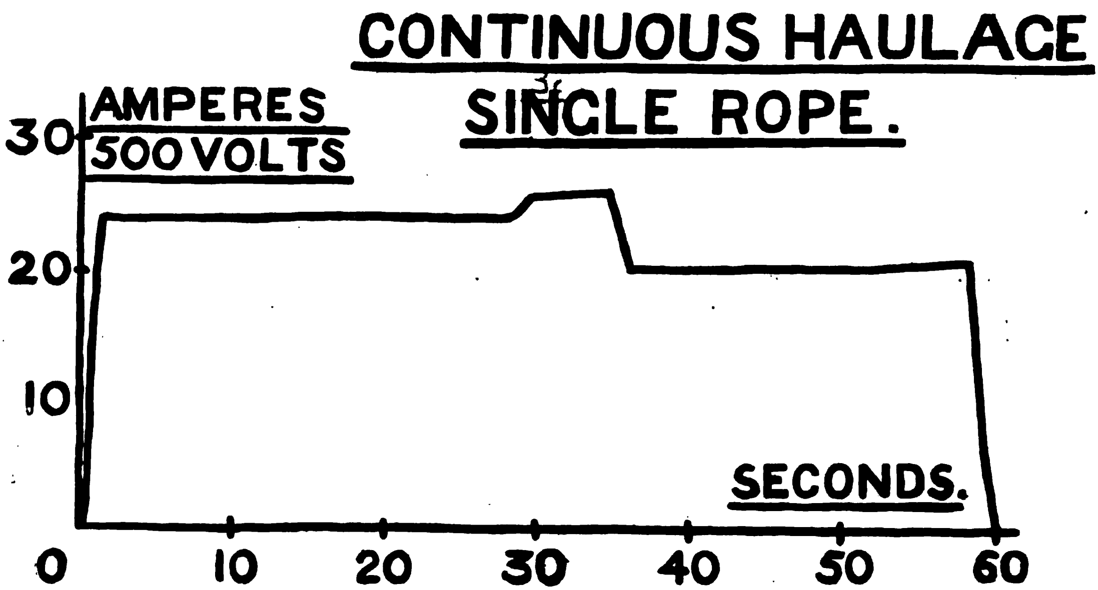
country, and the roads consequently more level. In many of their collieries the coal outcrops and the locomotives are able to bring trains out of the hillside without the intervention of a winding shaft. Electric locomotives are capable of working up an incline of one in twenty. A trolley wire or live rail cannot of course be used in fiery mines.

A Creeper is a form of conveyor to bring trucks from one level to another. They are frequently used at pit bottoms and on the surface. The load is somewhat intermittent, but the power required is small. Electrical transmission is extremely convenient for these small applications.

largely used. Dip pumps are mounted on a truck, and are moved down the falling roadway as the water is pumped out. Some very large pumps are in use on the Continent coupled direct to slow-speed motors.

Electrical driving is particularly applicable to centrifugal pumps, and it is on record that a pump of this kind is working against a head of 1,850 feet and raising 1,750 gallons per minute. A pump load is an extremely good one from the supply point of view, as the demand is practically steady. Electrical pumps are frequently placed in out of the way places, and receive attention perhaps twice a day. A very convenient and economical arrangement

Fig. 8.



Pumping.—This is a most important application. In some cases the weight of water raised exceeds the output of coal. The extreme flexibility of electrical transmission makes it particularly useful in the case of shaft sinking, and for following drifts and workings that are on a downward slope. In many cases very little power is required, as a very small pump will deal with 20 gallons a minute, but unless dealt with that flow of water will very soon flood out a large district. In one of the collieries with which I am connected, two pumps, absorbing together not more than 10 horse-power, have entirely cleared a flooded district, the water-level being reduced by 150 feet. The ordinary three-throw pump is a most useful type, and is very

can be obtained where the generating station supplies current for haulage during the day and for pumping at night. The capital expenditure is kept down in this way to a minimum.

Coal Cutting.—This is an extremely important application of power to mining, and a large number of electrically driven machines are at work. They can be divided into three classes, namely—disc, chain, and bar cutters. Special merits are claimed by the makers for each type of machine, the disc machine being most largely used in this country. The system of getting the coal known as long wall is generally employed where coal cutters are used, the machine usually making a horizontal cut from four to six feet deep underneath the

coal. As the cut proceeds the machine hauls itself along the face of the coal, being supported either on rails or on a sledge.

Series motors are generally used with direct currents. The Diamond Coal Cutter Company use two motors coupled in series. Multiphase motors are also successfully used for this work, but the great starting effort that a series motor will develop makes the continuous current machines more popular with the men, especially where deep holing can be carried out. The current is conveyed to coal cutter motors by means of long trailing cables well protected from injury, and arranged so that they can be readily disconnected.

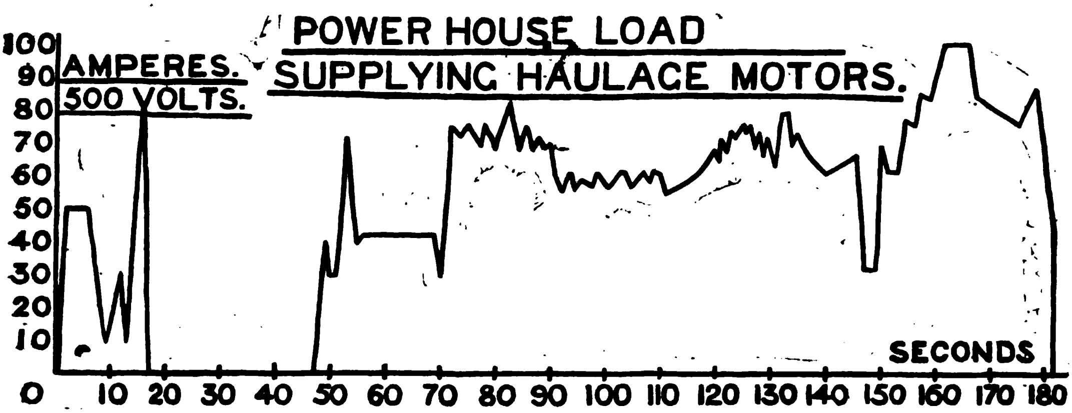
The main cables are generally brought to switch boxes in the gateways at several points along the face so that a long face can be worked without using cables of excessive length.

Electrically driven air compressors are being extensively used, and where rock drills are employed advantage is taken of the cheapness and flexibility of electrical transmission to drive the air compressors underground. Compressed air can be more safely used than electricity for coal cutting in very fiery mines, and electrically driven air compressors fixed some distance in-bye are also being used. There is good reason to believe that this combination of two methods of transmission is likely to be largely employed. There are numbers of other applications of electrical driving in mines, and it is interesting to note that a considerable discussion has been lately going on among engineers in the Rand as to the relative advantages of driving large numbers of stamps by one motor or dividing them into sections. It is likely that the latter system will survive, as the experience of engineers points directly to the great advantages to be obtained in sub-dividing the plant into sections of a reasonable size.

Generating Stations.—As I have already pointed out, the load on many classes of mining machinery is of a very variable character, and as a result, the demand on the generating stations is not always a satisfactory one.

In some cases where the haulage is continuous, and there is a good deal of pumping, a steady load is maintained for long periods; but to show that this is not always the case, I have a diagram (Fig. 9) showing readings which were taken for three minutes from a dynamo supplying three haulage engines varying in size from $7\frac{1}{2}$ to 25 horse-power.

FIG. 9.



You will see that at times there was no demand whatever. A dynamo running alongside and supplying screens and washing plant had a practically constant load of 90 amperes.

I should like to point out how important it is for effective governors to be used on the engine. I have known a case where the governors failed on a large proportion of the load being thrown off, the pressure rose from 500 to 1,200 volts, and a great deal of damage was done. Reliability, good running, and a minimum cost in repairs and attendance are always required in a mine, but extreme economy in steam consumption is not often attempted.

The steam pressures available are seldom more than 100 lbs. per square inch at the older collieries, and there is often a remarkable disregard for the fact that every ton of coal burnt, costs quite a large percentage of its actual selling value in labour, boiler repairs, and depreciation.

In spite of the above facts, in many cases a

remarkably low cost per unit generated is frequently obtained when there is a steady load extending over long hours. Capital costs, and consequently interest and depreciation, are kept down to a minimum. Attendance costs very little; for instance, an engine giving a steady output of perhaps 100 kilowatts for twelve hours a day, may be looked after by the fan engineman.

In some of the more modern plants the output is quite large, and high pressure steam and condensing are available. Gas engines supplied by coke oven gas will probably be very largely used in the near future, the reliability and economy of the modern gas engine placing it quite in the front rank among prime movers.

Cables and Distribution.—Owing to the fact that comparatively large powers are required at a considerable distance from the source of supply, and that in fiery mines a pressure of more than 500 volts is not available, the conductors have to be of ample section, and, in many cases, in order to avoid an excessive drop of pressure, the density does not exceed 300 to 400 amperes per square inch.

In the shaft it is necessary to support the weight of the cables, and this is usually done by fixing them in a tight fitting casing, or by cramping them between stout wooden cleats which are securely fastened to the walls of the shaft. Armoured cables are generally preferred for shaft work, the armouring helping to support the weight of the cable, and taking the stress off the insulation and the conductors.

In the mine the cables have to be carried in various ways, according to circumstances, but the most usual method is to hang them by means of cleats or leather thongs from the timbering. Armoured cables hung in this manner are remarkably free from serious injury, but where there is a danger of damage owing to trains running away on the inclines, or to falls of roof, they have either to be buried in the floor or specially protected.

The shaft cables are generally brought to a distributing point at the pit bottom, from which the cables to the various districts radiate. It is the best practice to build this distributing room of brick entirely fireproof, switchboards, or pillars similar to those used for tramway work, being arranged so that the cables can be conveniently coupled up. Where possible the engine planes, where trains are continually passing, should be avoided, the cables being carried along the travelling roads that are used by the men. Branches are made in suitable jointing boxes or in brickwork distributing rooms, similar in a smaller scale to that at the pit bottom. For coal cutters and portable motors, such as dip pumps, the cables are brought to a fixed switch box, and flexible cables carried on to the motors. The efficient earthing of all armouring and of the cases of switches and motors is an extremely important matter, and I am glad to say that this is required by the Home Office to be efficiently maintained. In my own practice I always employ separate cramps and conductors to make efficient contact between the outer coverings where junction boxes are fitted.

STATISTICAL ABSTRACT FOR THE UNITED KINGDOM.

The Statistical Abstract for the United Kingdom, just published (Cd. 2622), gives in succinct and authoritative form much of the data necessary to obtain a trustworthy view of the condition of the United Kingdom. The abstract opens with figures as to Imperial revenue and expenditure which show the enormous growth of the national charges in recent years. The period covered is for the years ended March 31, 1890-1, to the same date of 1904-5. In 1890-1 the receipts into the Exchequer amounted to £89,489,112, in 1904-5 they had risen to £143,370,404, an increase of £53,881,292. The revenue from Customs rose from £19,480,000 to £35,730,000; from Excise from £24,788,000 to £30,750,000; from Property and Income Tax from £13,250,000 to £31,250,000; from Post Office from £9,880,000 to £16,100,000. On the other hand, the cost of the army increased from £17,550,023 to £29,163,838; of the navy from £14,125,358 to £36,830,000; of the Civil List and civil administration from £17,637,557 to £28,843,630; of payments to local taxation accounts from nothing to £1,156,867; of elementary education from £5,293,703 to £14,235,728. Coming to particulars of Customs receipts, coal and sugar gave nothing until 1901-2; in 1904-5 coal yielded £2,052,774 and sugar £6,106,387. The yield from the tobacco duty increased as between 1890-1 and 1904-5 from £9,533,888 to £13,184,767, and from tea from £3,412,258 to £8,271,866; but the yield from wine and foreign and colonial spirits was less. So with the beer and spirit duties, both were less in 1904-5 than in the preceding year, but considerably larger than in 1890-1.

A very suggestive part of the abstract is that which gives the gross amount of income in classes brought under the review of the Inland Revenue Department for the purposes of the income tax. Taking the period as from 1891-2 to 1903-4, it will be found that the assessment of lands has fallen from £57,391,840 to £52,493,253. The fall in England has been from

£41,129,907 to £36,922,938, in Scotland from £6,318,581 to £5,852,773, in Ireland from £9,943,358 to £9,717,542, the fall in Ireland being much less relatively than in England and Scotland. On the other hand, "Houses, &c." have risen from £143,146,177 to £197,963,235, the increase in England being from £125,945,646 to £174,652,912, in Scotland from 13,425,504 to £18,556,183, and in Ireland from £3,775,027 to £4,754,140. The profits of businesses, &c., have increased in England from £229,173,045 to £317,126,464, in Scotland from £25,993,341 to £39,854,143, and in Ireland from £8,752,706 to £10,425,196. Noteworthy items are the increases in the salaries of Government, corporation, and public company officials in England. In 1891-2 salaries of Government officials in England amounted to only £16,060,000; in 1903-4 they had risen to £21,303,534. The increase in Scotland was from £291,475 to £300,870 only; whilst in Ireland there was an actual decrease, the amount paid in 1891-2 being £1,043,404, and in 1903-4 £1,025,910 only. The increase in the salaries of corporation and public company officials has been very heavy in all three countries; in England from £27,171,032 to £54,484,514, in Scotland from £3,459,230 to £6,397,133, in Ireland from £1,423,808 to £2,567,278.

It is the same with local taxation. In 1888-9 the outstanding loans of local authorities amounted to £195,442,397, in 1902-3 they had increased to £370,607,493. The expenditure in relief to the poor had increased from £8,366,477 to £13,609,570, school boards expenditure from £5,339,324 to £13,488,433; town and municipal authorities for police, sanitary, and other public works from £29,002,514 to £79,995,031; Rural District Councils spending £603,724 in 1888-9, against £1,799,632 in 1903-4. And so under every other head. The total expenditure of local authorities which in 1888-9 was £54,076,760 had increased in 1903-4 to £128,968,743.

Turning to the value of total imports from, and of total exports to the principal foreign countries and British possessions, it will be found that our trade with Russia shows considerable and fairly steady expansion. In 1890 our total imports from Russia amounted to £23,750,868, in 1904 they had increased to £31,402,838; in the same years the exports were £8,846,054 and £15,285,157 respectively, so that in the fourteen years the imports had increased by about 40 per cent., and the exports had nearly doubled. In the same period our imports from Denmark more than doubled from £7,753,389 to £16,101,808, exports increasing from £2,928,006 to £4,031,248; our imports from Holland increased from £25,900,924 to £34,689,639, but our exports fell from £16,445,992 to £12,909,663. Our imports from France increased from £44,828,148 to £51,107,046, but exports decreased from £24,710,803 to £21,702,405. With Germany, there was improvement in both directions. Imports increased from £26,073,331 to £33,944,322, and exports from £30,516,281 to £36,427,850. Imports from the United States showed great expansion, from £97,283,349 to £116,025,357, but exports fell from £46,340,012 to £39,272,433. Turning to the Colonies, our trade with Canada shows considerable expansion. In 1890, the imports amounted to £12,020,162; in 1904, they had increased to £22,621,164; whilst the exports to Canada rose from £7,809,809 to £12,248,342. The imports from Australia increased from £20,992,185 to £23,568,918; but the exports fell from £21,750,705 to £19,841,230. Imports from New Zealand increased from £8,347,430 to £12,741,510, and exports from £3,705,428 to £6,897,420. British India shows less rapid, but not inconsiderable expansion. In 1890, the imports were £32,668,797; in 1904 they had increased to £36,472,636; the exports for the respective years being £35,230,114 and £41,544,494. Taking the total of British possessions, the imports increased from £96,161,214 to £120,018,406; and the exports from £94,522,469 to £120,783,496; whilst the imports from foreign countries increased from £324,530,783 to £431,020,222, and the exports from £233,729,649 to £250,231,825. The advance in the value of the total imports and exports of merchandise at the ports of Liverpool and London has been very close. In 1890, for Liverpool, the figures were £226,218,508; and in 1904, £262,463,869. For London, in the earlier year, £233,528,425, and in 1904, £269,471,757.

Turning to population, that of Scotland exceeded that of Ireland for the first time in 1901, when it was 4,483,880, as against 4,445,630, and in 1905 the change to the disadvantage of Ireland had increased, the population of Scotland having risen to 4,676,603, and that of Ireland fallen to 4,388,107. The following figures, showing the shifting of population in the three kingdoms in the last half century are noteworthy:—

	England and Wales.	Scotland.	Ireland.
1851	17,927,609	2,888,742	6,552,385
1905	34,152,977	4,676,603	4,388,107

The rate per 1,000 of the population married in England and Wales in 1890 was 30·2, in 1904, 28·0; in Scotland, in the same years, the fall was from 30·4 to 28·6, but in Ireland there was increase from 22·3 to 23·6, which still leaves Ireland much below the rest of the kingdom. The death-rate in England and Wales, taking the same year, fell from 19·5 to 16·3, and in Scotland from 19·7 to 16·8, but in Ireland it was practically stationary, 18·2, as against 18·1. Marriages in England and Wales show a trifling decrease from 15·5 to 15·3, in Scotland a trifling increase from 13·7 to 13·9, and in Ireland a more substantial rise, from 8·9 to 10·4. The number of male criminal offenders committed for trial in England increased from 10·075 in 1890 to 11·147 in 1904, and in Scotland, from 1,909 to 2,353, but in Ireland they fell from 1,728 to 1,566. The number of paupers in receipt of relief, taking one day in the winter, in England and Wales in 1891 was 774,905, and in

1905, 914,743; in Scotland the increase was from 93,289 to 110,436, but in Ireland there was a decrease from 106,710 to 102,401. Ireland continues to furnish the greatest number of emigrants in proportion to her population. Of the number of English, Scotch, and Irish passengers that left the United Kingdom for countries out of Europe in 1904, 175,733 were English, 37,445 Scotch, and 58,257 Irish. The corresponding figures for 1890 were 139,679 English, 20,653 Scotch, and 57,484 Irish, so that with a population nearly half-a-million smaller in 1904 than in 1890 the Irish emigration was larger. The larger number of the emigrants go to the United States. Taking last year, 146,445 went to the United States, 5,486 to other foreign countries, 69,681 to British North America, 13,910 to Australia and New Zealand, 26,818 to British South Africa, and 9,095 to other British colonies and possessions.

CAPE EDUCATION: ITS DIFFICULTIES AND DEVELOPMENT.*

In 1652, under the leadership of Van Riebeek, a permanent settlement was made at the Cape of a number of servants of the Dutch East India Company, most of them soldiers and sailors, and many not of Dutch origin. Severe restrictions, imposed in the interests of the company, hampered the energy of these settlers, even sea-fishing being restrained, and the colonists being compelled to follow a pastoral and agricultural life. The Huguenot exiles in 1688, few in numbers, but numerous in proportion to the whole population, by intermarriage with the original settlers, affected strongly the subsequent character of the race, and the forcible suppression of their own language led to the modification of the adopted one into the interesting form now surviving in "the Taal."

In the absorbing cares of a new settlement, little attention was paid to education, and the office of schoolmaster was for many years combined with that of "Ziekenrooster," or sick visitor; later, with that of "precentor" to a country church. The disturbed state of Europe at the close of the eighteenth and the beginning of the nineteenth century affected the Cape, leading to its passing finally under English rule in 1806. The arrival of the British settlers in 1820 introduced a new element into the population of the Eastern Province, giving it a distinctive character to-day. Although a few schoolmasters were imported from Scotland in 1822, and the South African College founded in 1829, there was no organised scheme of education until the introduction in 1839 of the "Herschel System," based upon certain recommendations of Herschel, the astronomer, who resided at the Cape from 1834 to 1838. A Superintendent-General was appointed, Mr. Rose-Innes, who acted as inspector of all schools for twenty years. Certain "Established" schools, entirely supported by Government, provided instruction to the burgher children in English. Other schools receiving subsidy only were called "aided" schools. The great difficulty continued to be the provision of education for a thin population scattered over an enormous pastoral area. The itinerant schoolmaster was chiefly employed, teaching a few months here and a few months there, imparting in that brief period all the instruction many children ever had. The pastoral habit and the isolation of the farmhouses tended to develop that character of independence so marked in the farming community to-day. For the problem of providing education for the rural population various solutions have been offered by Education Commissions and experts from time to time, but the question is still a most serious one. The progress of education during Mr. Rose-Innes's term of office was quiet and steady, the most remarkable development taking place towards the close of that period in the appointment of a Board of Seven Examiners, the nucleus of the present University of the Cape of Good Hope. Certificates were to be granted of a standard corresponding to that of a degree in arts in Universities in the United Kingdom.

When Dr. Dale assumed office, in 1859, the "Herschel System" had practically served its purpose, and an Education Commission, appointed in the early sixties, led to the Education Act of 1865, the basis of the system in operation to-day. A local guarantee was first necessary, and the Government subsidy was to be on the principle of pound for pound for schools for the children of such parents as could afford to pay half the cost. Other schools of a lower class were designed for the poorer Europeans and the aborigines. A Board of Guarantors, appointed every three years, was responsible to the Government for the proper conduct of each school, but the weakness of the whole system lay in the want of provision for continuity and permanent buildings. The highest tribute to Dr. Dale's administration lies in his success in enlisting in the management of the schools the co-operation of so many of the best representative men in the colony. In the larger centres the system worked satisfactorily, but in small villages and country districts the life of the school was often precarious. In 1872 the appointment of two deputy-inspectors relieved the Superintendent-General of that part of his duty. In the following year came the establishment of the University, superseding the old Board of Examiners. It was to be an Examining University, like the London University, granting degrees in arts, law, &c., and certificates in land surveying. Grants were to be issued to certain institutions preparing for these higher examinations, but, unfortunately, still on the pound for pound basis.

In elementary education the lack of teachers

* Paper read by the Rev. W. E. C. Clarke, M.A., before Section L of the meeting of the British Association at Cape Town.

continued to be the great obstacle. The establishment of a Normal Institution in 1840 had produced nothing, and the attempts at developing a pupil-teacher system had also failed to remedy the defect. In 1879, the Dutch Reformed Church established a Normal College, which, under Mr. Whitton, has rendered great services in the last twenty-five years. Denominational effort had also contributed its share to the development of education, the Diocesan College at Rondebosch being the most distinguished of such institutions; but many others, although entirely unaided by Government, doing excellent work, and holding their own in competition with the more fortunate Public Schools.

Another Education Commission, in 1879, advised the division of the functions of the Superintendent-General between two officials, an increased number of inspectors, the removal of language restrictions in the medium of instruction, and the substitution of corporate bodies with rating powers for boards of guarantors. Parliament gave effect to some of these recommendations, but the guarantee system was left unchanged.

An Inspector-General of Schools, Mr. Ross, appointed in 1882, published a report of remarkable importance, pointing out especially the unique character of the Education Department as an autocracy in the midst of responsible government, and indicating the question of rural education as the chief difficulty, and the training of teachers as the most urgent want. He advised the employment of itinerant teachers for remote districts; but the longer experience of Dr. Dale led him to describe this suggestion as impracticable, as such a "vagabond" life had failed to attract competent men. He preferred the subsidising of private farm schools, with even five children enrolled. Other criticism at this time called from him a defence of the guarantee system, as providing a check on extravagance and securing the aid of those chiefly interested in the success of the schools.

Another Education Commission in 1891, besides suggestions affecting the agricultural population, technical education, and the question of school boards, made the following pronouncement on the language question:—"The choice of the linguistic medium and the decision as to whether it should be double or single seems to be a matter fairly within the parents' sphere, and neither the Education Department nor any School Board should be empowered to make either Dutch or English the sole medium of instruction in any school." Parliament had already, in 1882, removed all language restrictions.

The fact that the Superintendent-General has been an autocrat has had this advantage, that each occupant has, during a long term of office, been enabled to develop a consistent policy. The personality of the present Superintendent-General, who took office in 1892, has impressed itself strongly on Cape Education. The thorough organisation of elementary education, the development of an extensive pupil-teacher system, and the training of teachers have achieved great results. The latest Blue-book shows 2,700 schools in operation, 1,400 of these being for European children, with an enrolment of over 60,000; there are 28 inspectors, besides a number of departmental instructors in special subjects. Notwithstanding the large increase in the number of schools, the percentage of certificated teachers in those for Europeans is 71, the proportion being lowered by the lowest class of schools.

This satisfactory result has been achieved partly by the development of training-schools and other means of instruction for pupil-teachers, and also by an extensive system of Vacation Courses of Lectures by experts for the improvement of teachers in schools.

The development of boys' and girls' handiwork has been a marked feature of the new *régime*, and an annual exhibition of work and departmental examinations in this, as well as in science and other subjects, have proved a great stimulus. But as regards such tests and incentives, local examinations instituted by the University have for years provided a field for competition among all schools, and have been so sought after to assume, in the opinion of some, an undue degree of importance.

Cape education has all along developed very much on its own lines, and it has been the merit of the administration throughout to move forward less by radical changes than by adaptation of existing methods and machinery. This is evidenced in the remarkable increase in good school buildings, a result gained in spite of the want of continuity in the school committees, and without sacrificing the pound for pound principle. The Building Loan Scheme is probably Dr. Muir's most successful achievement. From the outset secondary work was combined with primary in the better schools, but during the last few years between thirty and forty High Schools have been established, with a special curriculum arranged for them, leading up to the matriculation certificate of the University. The new Education Act, while retaining committees for individual schools, will provide School Boards for municipalities and large areas, with rating powers and with control over the committees in their area. One-third of each Board is nominated by Government.

A few institutions preparing for the University certificates and degrees were subsidised under the Higher Education Act of 1874, but as the number of students increased, the idea arose of uniting the work of these separate colleges into a Teaching University. While vested interests and keenness of rivalry have hitherto prevented such unification, the development of these separate colleges has proceeded rapidly, and it seems likely that the Teaching University of the future will consist of certain constituent colleges. That these shall not be too many, and that their relation to the University shall be a satisfactory one, are the difficulties involved in this question. The Rhodes Scholarships, while benefiting the indi-

vidual holders, will also further Higher Education if made post-graduation scholarships; in the original scheme they might have tended to do actual injury to Higher Education in the colony.

A School of Mines was instituted at the South African College in 1896, and the students now complete their course at the Johannesburg Technical Institute.

While the progress of education has thus proceeded satisfactorily along various lines, it cannot be said that the position of the teacher has improved in a corresponding degree. It is true that the increased influence of the body of teachers is the most remarkable fact in modern education, and the Union of Cape Teachers in the South African Teachers' Conference, with its branches all over the country, has enabled them to speak with a strong voice on important questions, and to combine for purposes of mutual defence; but it is matter for regret that so great a proportion of time and interest has been devoted in their meetings to questions of salary, pension allowances, and other factors making for the comfort of their position. It should not be necessary for teachers to have to assert their rights and to impress their claims on the rest of the community. The new Education Act arranges for greater security of tenure and for improvement of salaries, but satisfactory provision has yet to be made for pension on retirement. "The teacher should be removed beyond fear of want and anxiety about financial concerns. The community is not in a healthy condition in which education is not held in honour."

FUR AND SKIN DRESSING IN AUSTRALIA.*

Although considerable quantities of opossum, wallaby, and other marsupial skins, together with a fair proportion of bird-skins and various kinds of fur, are annually exported from the Commonwealth, nearly the whole of which is sent out in an undressed condition, instead of being put up in a finished state and consequent securing increased employment and remuneration for those engaged in the industry. At present there are only a dozen skin-dressing establishments in Australia, yet the value of the undressed skins exported during 1904 was £186,759. This does not include skins obtained from outside the Commonwealth, nor those of sheep, rabbits, or hares; although the two latter are capable of being utilised for numerous industrial purposes. Neither is leather made from kangaroo skins included. The whole of the skins and furs dressed in the Australian States is intended for the local markets, the demand being greatest during the winter season. To make a good-sized rug, from four to five dozen opossum skins are required, the most expensive being the black furs from Tasmania. There are several kinds of opossum in Australia, the most numerous being the common opossum, which is covered with a fine long fur, of a woolly texture, and of an ash-grey colour. It is generally tracked and shot on clear moonlight nights, when its form can be detected lying on the branches of the trees frequented by it. The mountain opossum is of a larger size and its skin is consequently more valuable. It is found mostly on the great tablelands and on the confines of the snow country in which the waters of the Murray take their rise. Here the trappers arrive in winter-time and build rough huts, in which they remain for several weeks, issuing each morning in search of the tracks or clawmarks made by the animals in the soft bark when ascending the gum-trees. When these are found logs are placed in a sloping position against the trees, and soon the animals learn to run up these on their way to the upper branches, where they are easily trapped. Winter is the best time for hunting fur-covered animals, the fur then being thickest and most soft and glossy. The skins of the kaola, or native bear, a harmless animal about two feet in length, the flying squirrel, the wallaby, or brush kangaroo, and various kinds of kangaroo are obtained in immense numbers every season. Yet the animals are still abundant in the unsettled and sparsely inhabited districts; and in many places "kangaroo drives" are periodically organised for the purpose of keeping down the numbers of the strange-looking marsupial, which otherwise would leave little herbage to be cropped by the sheep and cattle in the vicinity. Platypus skins are rapidly becoming scarce, and in Victoria the platypus is protected by law all the year round. The skin resembles that of the otter, and is sometimes known in the trade variously as silver or golden otter. It is a fur very popular for ladies' winter wear. and when the coarser outer hair becomes shabby it is plucked away, revealing beneath a dark second coat of beautiful lustrous fur resembling the finest sealskin. The platypus lives and breeds in a burrow, the opening of which is in the river bank below the water. The water gradually rises until the terminus is above the water level. The burrow is thus rarely found, and the popular plan is to shoot the platypus, when, as is its custom, it is quietly floating down with the current in the twilight, or during the day when the stream is in flood and the water discoloured. The demand for hare and rabbit skins, in good condition, is practically unlimited, the fur being used in the manufacture of the felt hats now generally worn. The kangaroo skin is valued both as a fur and for the production of leather; the fur, which is soft and silky, is of a reddish colour. Although dressed furs to the value of £6,462 were imported during 1904, fur-dressing in the Commonwealth, as before mentioned, remains practically an undeveloped industry, so far as export purposes are concerned, the exports during the same year not exceeding a value of £220, yet in Victoria and Tasmania large numbers of beautiful rugs are annually made for the local markets, where they find an immediate and remunerative sale. The skins of the native cat, the

* Communicated by Mr. John Plummer, of Sydney, New South Wales.

native tiger, the bandicoot, and other small native animals, are also much used for the production of small rugs and mats.

LABOUR-SAVING MACHINERY IN CHINA.

The conservatism of the Chinese with respect to the introduction of labour-saving machinery in China is proverbial, and the chief reason given is that the introduction of such machinery would be harmful in a country where there are millions of people who will starve if there is the least disturbance of the demand for their labour. To argue that there will soon be a readjustment of things in case such machines are introduced, and that the people ultimately would be greatly benefited, is met with the reply that millions would starve while the readjustment was coming. The United States Consul at Hangchau states that while there is a great deal of truth in this argument, the Japanese would seem to be solving the problem for China by the introduction of machines which save some labour, though not enough to suddenly deprive any considerable number of people of work. One example of this is to be seen in a foot-power cotton gin, which is now quite common in some parts of the country, where the people manufacture their own cotton goods and handle their own cotton crop generally. The old method of ginning by hand is infinitely tedious. One of these foot-power gins will enable a workman to turn out about one hundred pounds a day. The machines are roughly constructed and very cheap. They will enable their owners to accomplish far more than they could without them, and at the same time will cause no disturbance. They represent a step in the direction of better things in China's cotton world, but the step is not a very long one. A similar condition is to be found in silk reeling. The Japanese have designed a silk reeling-machine constructed of wood, with a few glass eyelets and metal fittings, which they regard as a considerable improvement over the old Chinese machines similarly constructed. An expert on the Japanese machine can reel more, and better silk, in a given time than an expert can on a Chinese machine. At present, however, the Chinese seem disposed to cling to their old machines, and the mass of work done outside of the steam filatures, is done on the old-fashioned Chinese machine. The Japanese have control of the markets in the Hangchau district of China, and over most of the Chinese Empire, for many things of apparently small moment, and certainly of small cost. This is true of cheap classes of cotton goods, toilet articles, light hardware, and small goods generally. The Consul-General adds:—"It looks very much as though the Japanese were watching the markets of China very closely, not only that they may supply these cheap machines for saving some labour at the present time, but that they may thereby pave the way for greater improvements and more radical changes which the Japanese themselves will make, and, incidentally, which will be able to advance their own commercial interests. It may be relied upon that each successive stage in the changing commercial and industrial conditions of China is carefully noted and acted upon by them. At the preesent time the Japanese seem to be the only people who are giving to Chinese markets that close attention which the control of them necessarily entails."

INTERNATIONAL FIRE CONGRESS AT MILAN.

The Italian Technical Fire Brigades Federation has made arrangements to hold in Milan, in May, 1906, a congress with brigade competitions, for the prevention and extinction of fires, under the auspices of the civic authorities of Milan, and of the committee of the international exhibition to be held there next year. The congress, according to the United States Consul at Milan, is to last seven days. The mornings will be given up to work, and discussions, and the afternoons to receptions, visits to the city, excursions, &c. The Milan firemen will give exhibitions during the afternoons, and there are to be reviews of the brigades. The following are eligible to take part in the congress:—Officers of any public fire brigade in Europe or America, commanding officers of private fire brigades for the extinction of fires, and directors of companies, and those of fire insurance societies, together with all persons interested in the development of defences against fires, such as managers of public and private institutions, owners of houses and factories, or any other persons equally interested or involved. The competition will be open to all fire brigades — municipal, volunteer, or private. All foreign members who are not official delegates of governments or corporations, and who are not members of the central committee or of some of the local foreign sub-committees, must subscribe the sum of eight shillings towards the expenses of the congress. In addition to medals, diplomas, and special works of art offered by the committee as prizes in the various competitions of the congress, money prizes will be offered for rewards in the tests between foreign brigades. Everyone taking part in the congress will be presented with a decorated souvenir. All competing members will be provided with military lodgings free, if they are applied for in advance, though this is not extended to visiting officers. Horses will also be stabled free, and provision will be made for storing apparatus and material. Italian is to be the official language of the congress, but papers may be read in English if a translation is filed with the executive committee two months before the opening of the congress. Ten minutes will be allowed to each speaker. Entrance registration closes March 1, 1906, and entries for technical communications and conferences will close on February 1.

HOME INDUSTRIES.

Hops and Hop Picking.—The annual exodus of the very poor from London to the hop-fields began last week. On Tuesday, August 22, the first of a series of heavy-laden trains left London Bridge carrying "hoppers" to the Weald of Kent. It has been estimated that for the hop picking alone over a quarter of a million "strangers" come into the different hop-picking districts to do it. "There are thousands, and tens of thousands of the poorer population," said a witness before the Royal Commission in 1891, "who get a month's outing from the dark courts and alleys of London, and get fresh air, healthy exercise, and profitable employment, and one of their chief pleasures is a month among the hops, with the prospect of returning to town richer, not only in pocket but in health." Years ago serious abuses were associated with these gatherings of the "residuum" in country districts. But of late there has been great improvement in the housing and supervision of these people. They are for the most part lodged in well-built and well-ventilated "huts," and given separate rooms. These rooms have a fireplace, and are well whitewashed before the pickers arrive. They have a good supply of clean water, and there are inspectors to see that food is pure and good. Services are provided for them on Sundays, and in many of the villages coffee-stalls are organised by ladies of the village to provide coffee and soup at cheap rates. On the whole, and speaking generally, there has been marked improvement in the arrangements for the treatment of the hop-pickers.

The Acreage in Hops, and Price.—The area covered by hop cultivation in the United Kingdom was never very large. No hops are, or have been, grown in Wales, Scotland, or Ireland. The cultivation is confined to England, and mainly to the four counties of Kent, Sussex, Herefordshire, and Worcestershire. The largest acreage ever planted was in 1878, when it was 71,000 acres. Then it went down gradually to rise again in 1885 to the same acreage. Since then the acreage has fluctuated, but the tendency has been downwards. In 1894 it was 59,535 acres, in 1900 it had fallen to 51,308, and last year it was only 47,799. The price of hops fluctuates widely, but if an average of years is taken, the fall is not very marked. Thus the price in 1885, when the acreage was at its maximum, was £4 8s. per cwt., next year it fell to £2 18s. 6d., in 1889 it was £4 11s. 6d. In 1882, one of the worst crop years on record, the quotation rose to £21 2s., and in 1888 touched bottom at £2 17s. 7d. Of the 282,330 cwts. of English hops produced last year 216,807 were grown in Kent, Sussex coming next with 27,726 acres, and Hereford third with 14,101.

The Cost of Cultivating Hops.—There is plenty of suitable land available for hop cultivation, but its risks are too great to attract. Moreover, the demand for hops does not increase in anything like proportion to the growth of population. The cost of cultivation is very heavy. The following are items given by one of the best known of Kent growers, Mr. James Selmes. Taking one acre, as representative of the ordinary area of a hop plantation, ploughing costs £1; harrowing 5s.; setting out of plants 12s.; planting 30s.; hop sets (that is, the cuttings put in to raise the plants from) £5 8s.; manure £2 10s.; another species of manure is generally used, namely, rape cake, £3; the chopping of the hops round the hills 6s.; the stakes put up 12s.; tying 1s.; the stroking out of the furrows to let off the water 5s.; the rent and rates, including the extraordinary tithe redeemed £2; the extraordinary tithe 4s.; and then, before you can start your acre of hops, you must supply the poles for the hops to grow upon for the next year, which will come to £27 an acre. That makes £44 13s. This expenditure only carries as far as the first year's planting. As regards the second year, the items mount up to £40 5s., of which labour—that is to say, horse labour and manual labour—comes to something like £17.

The Profits of Hop Growing.—Roughly speaking, the hop grower has to find £40 per acre for an average crop. His profit is derived from whatever he may get per acre over and above £40. How greatly it varies is shown by the figures given above. Hop growing can only be made to pay by striking an average of years, and nearly all experience goes to show that it is in the short cropping years that the losses of other years are very often made up. For instance, take the high cost of picking alone. On very small acreage it has sometimes come to as much as £400 on a large crop, whereas upon a smaller crop of from 5 cwt. to 7 cwt. an acre instead of 18 cwt. it would be reduced by half. You cannot lay down any rule that because a crop is a small one therefore it shall be a good or bad one, or because it is a large one therefore it shall be a good or bad one. Quality, which is dependent upon the atmosphere, and price, to some extent affected by imports, are the determining factors, due regard, of course, being had to demand. And no crop is more dependent upon the weather than hops, perhaps none as much. A crop that has been all its grower could wish up to within a fortnight of maturity may be irretrievably injured by a few days of bad weather just prior to picking. In 1885, 71,327 acres produced only 509,170 cwt., in 1899 51,843 acres produced 661,373 cwt. The yield in the one year was 7·14 cwt. per acre, in the other 12·76.

Hop Cultivation and Labour.—What the shrinkage of the average under hop cultivation means to labour will be understood from a few comparative figures. There is no branch of agriculture that employs so much labour as the hop cultivation, nor half, nor even a fourth. Its abandonment would be a very serious thing to the agricultural interests of the

counties in which hops are grown, more especially Kent. The cost of growing an acre of wheat is about £4 for labour and £4 for manure. If you take 4½ qrs.—3½ is the average—at 32s., the gross value would be £7 4s. Putting the straw at £2, would give the total receipts £9 4s. Put at its highest—and it would be very high—the cost of labour for the acre of wheat would not exceed £4 per acre; the labour on an acre of hops sometimes come to £20 per acre. Labour and manure for the acre of wheat would, at the highest, come to £8, for the acre of hops £26. A hundred acres less hop cultivation in a village means from £1,700 to £2,000 less for labour. For every three acres grubbed a man must be discharged. Three acres under hop cultivation would furnish a labouring man with the means of keeping his family. It would require 50 or 60 acres of pasture to do the same thing, and not very much less of ordinary arable cultivation.

The Imports of Hops.—Whilst the home acreage under hops has diminished, the imports of hops have decreased if those of 1904 are excepted. In 1884 the imports amounted to 256,777 cwts., in 1894 to 189,155 cwts., in 1900 to 198,494 cwts., and in 1903 they had fallen to 113,998 cwts. In 1904 they ran up to 313,607 cwts., but taking the twenty years, and allowing for wide fluctuations, imports dwindled notwithstanding the decrease in the home production consequent upon decreased cultivation. The explanation is to be found in shrinking demand. The very high price of hops in 1882—£21 per cwt.—led brewers to turn their attention more closely to the cost of production. They found it possible by the use of ice to brew all through the hot weather; the consumption of beer became more rapid, it was no longer necessary to keep large stocks for many months, the public taste altered, and brighter quality of beer, less heavily hopped, came to be preferred. The result was that the proportion of hops used to a quarter of malt was reduced to an amount estimated at 1½ lb. per quarter of malt, or 15 per cent. Add a reduction due to a reduced consumption of malt estimated at 12 per cent., and the two together account for largely reduced demand and consequent fall in price.

Substitutes for Hops.—The popular idea that many substitutes are used to perform the work of hops in the manufacture, flavour, and keeping of beer does not seem to be well founded, at any rate, in the case of the leading breweries. Lord Burton has stated categorically, "We have no hop substitute in any shape or form," and he went on to say that "Practically no one here (in Burton) uses hop substitutes. Owing to the trade having become so much more a 'running' one (running beers intead of stock beers), and the increased demands for light beers, the consumption of hops per quarter has decreased." Many breweries, since 1882, are said to have made a reduction of quite 20 per cent., on account of the light beers, in the use of hops. It is not, of course, intended to convey that substitutes, such as Colombo root, camomile, quassia, cheretta, are not used in some breweries. There are firms who advertise these substitutes, and there is great difficulty in detecting the use of substitutes, but their use is comparatively small, and confined to second-rate breweries. For none of the substitutes equal the hop for the purposes for which the hop is used, which are—(1) to precipitate or render insoluble, certain nitrogenous ingredients of the wort; (2) to preserve the beer by preventing a renewal of fermentation during the time before it is fit for consumption; (3) to give it the bitter taste to which the public have become accustomed, and (4) to give it a delicate aroma. None of the various drugs advertised as substitutes for hops perform any of these functions except the third, so that most of the drugs referred to can only be used as substitutes for a small portion of the hops which would otherwise be used. New York and Californian hops are largely used by Burton brewers.

Hop Growing in the Future.—It may be gathered from the facts given above that the acreage under hops is not likely to increase. Imports keep down the price and the price must be high to give an adequate margin for risk. The profit over a series of years is not high enough to attract the speculator, and the prudent not already associated with it shrink from embarking in an industry which involves a very heavy outlay of capital that may be lost, or much lessened, by a few days unfavourable weather. Something like £40 has to be spent upon every acre of a well cultivated hop field. Now, taking the average yield of the seventeen years, 1885-1901, it was 8·40 cwts. per acre. The yields ranged between 12·76 in 1899 and 4·81 in 1888, and in 1899 prices receded to such an extent as to leave no margin of profit to the great body of growers. To cover the cost of cultivation, and assuming an average crop of 8½ cwts., the average price obtained would have to be roughly £4 15s. per cwt. to cover charges. It may be doubted whether the average sales reach that figure. The following is from the market report of *The Times,* dated August 26th, and relating to Kent and Sussex hops. "On the market, brewers, attracted by the low prices, are showing more interest in the remaining 1904 hops. Values range from 70s. to 90s. per cwt." It would seem probable that, taking one year with another, the hop-grower does not get a substantial return upon his capital, or one anything like commensurate with the risk run.

OBITUARY.

ALFRED WATERHOUSE, R.A.—Mr. Waterhouse, the eminent architect, died on the 22nd of August, after a long illness, at his residence, Yattendon-court,

Berkshire. He was born on July 19, 1830, and educated at Grove-house School, Tottenham. He afterwards became an architectural pupil of Mr. Richard Lane, of Manchester, then travelled and studied in France and Germany, until in 1853 he began practice on his own account in Manchester. His first great work was the Manchester Assize Court, the designs for which obtained for him the commission in a hotly contested competition in 1863. The buildings from his designs in Manchester, Oxford, Cambridge, Leeds, Liverpool, and especially London, are many, and the Natural History Museum, at South Kensington, is perhaps the best known of them all. Many of his large buildings, such as courts of law, town halls, hospitals, museums, clubs, the Central Technical Institute, Prudential Assurance Offices, required special skill in the planning, and in this department Mr. Waterhouse was a recognised master. His earliest works are in the style of the Gothic revival, but later he considerably modified this, and at all times he exhibited great originality of treatment. He was elected A.R.A. in 1878 and R.A. in 1885. For a time he was treasurer of the Royal Academy. He became a member of the Society of Arts in 1901.

GENERAL NOTES.

CHEAP CLOTHING IN CHINA.—It does not cost much to clothe a Chinaman in Wuchow. Reporting on the trade of the place, Mr. Acting-Consul Williamson (No. 3449, Annual Series) says that the nankeens worn are woven from Indian yarn and are very popular amongst the poorer classes in the province, since, in spite of the large and increasing import of foreign piece goods, nine-tenths of the people are too poor to wear anything but native cloth, which, though not any cheaper than the foreign article, is far more durable and suitable for all seasons. A complete suit, consisting of coat and trousers, costs, made to order, about 3s., and worn daily will last a whole year. A couple of such suits, worn one over the other in winter, is about all the clothing the average peasant possesses. Many of them weave the cloth themselves from Indian yarn, but not to the same extent in Kuangsi as in other provinces, owing to the laziness of the natives. It is probably from this reason that at the Industrial Institute at Wuchow, the weaving of cloth has been the only industry of the many attempted which has been found to pay. It is produced at a cost of 1½d. a yard, 13 inches wide, and finds a ready sale at 1¾d. a yard. The weaving is done entirely by boys between 12 and 15 years of age.

TRADE WITH MOROCCO.—Mr. Consul Maclean's report on the trade of Dar-al-Baida, for 1904 (No. 3443, Annual Series) shows that the United Kingdom maintains her position in the markets of Morocco, Germany being third in relative importance, France coming second. Of the coast trade of the district, the United Kingdom took 47·27 per cent., France 21·06 per cent., Germany 15·66 per cent. The per centage of the total trade that fell to the United Kingdom was 47·27, against 21·06 for France, and 15·66 for Germany. The per centage was much the same throughout the consular district, which includes Rabat, Dar-al-Baida, Gaffi, and Mogador. Owing to the drought, the exports for the present year are likely to show a considerable falling off. Mr. Consul Maclean says that manufacturers of domestic sanitary appliances, and of roofings suitable to withstand the hot sun of summer and the heavy rains of winter, should direct their attention to the potentialities of the market. There is no great opening at present, but trustworthy agents should be provided with samples of strong, simple, and inexpensive goods. House and store fittings, such as locks, hinges, window frames, &c., are likely soon to be required, and there is a growing market for cheap lines of ready made clothes for men and youths, owing to Morocco Jews and Jewesses discarding their native dress in favour of European apparel.

EMIGRATION.—During the quarter ended June 30th, 134,745 emigrants left the United Kingdom for places outside Europe. Of these 81,843 were natives of the United Kingdom, of whom 51,356 were English, 13,515 Scottish, and 16,972 Irish. The proportion of emigrants accredited to the several parts of the United Kingdom per million of the respective estimated population were as follows:—England, 1,504; Scotland, 2,890; Ireland, 3,866. But whilst Ireland retains the lead as the great emigrating section of the Kingdom, proportionately the Irish emigration shows decrease. The proportion of English emigrants showed an increase of 17·1 per cent., the comparison being with the averages in the three preceding second quarters, the Scottish an increase of 31·1 per cent., and the Irish a decrease of 5·2 per cent. Turning to the statistical abstract of the United Kingdom, it will be found that up to the end of 1904, a very large proportion of the emigrants of British nationality went to the United States, and there is no reason to suppose that a large majority are not going there this year, but in 1904, no less than 69,681 out of a total of 271,435 went to British North America, and probably this year's figures will show an even larger proportion. Last year the number that went to the United States was 146,445.

MEETINGS FOR THE ENSUING WEEK.

WEDNESDAY, SEPT. 6...Institute of Sanitary Engineers, 11, Bloomsbury-square, W.C. Election Committee at 3½ p.m. Organising Committee at 5 p.m.

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FRIDAY, SEPTEMBER 8, 1905.

NOTICES.

EXAMINATIONS.

The Programme for 1906 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The subjects include: — Book-keeping, Accounting and Banking, Shorthand, Type-writing, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 2, 1906.

Before 1905 the Examinations were arranged in two Grades—Preliminary and General. The Preliminary (Grade I.) corresponds with the present Elementary Examination (Stage I.). The Third-class, and the lower part of the Second-class of the former Grade II. correspond with the present Intermediate, or Stage II., and the First-class, wlth the upper part of the Second-class of Grade II., correspond with the present Advanced, or Stage III.

The papers now set are of the same character as those of the previous years, which will therefore, as hitherto, form a useful guide to the nature and scope of the Examinations.

Candidates who have not previously passed in the Society's Examinations are strongly recommended to enter in the first instance for the Intermediate Stage.

The only alteration of importance in the Examinations for the present year is in Shorthand. Formerly all the different Stages of Shorthand were taken on the same evening. The different Stages will now be taken on two evenings: Advanced (First-class 150, Second-class 120 words per minute), and Elementary (50 words) on one evening; Intermediate (First class 100, Second-class 80 words per minute) on another.

The alterations originally proposed have been considerably modified in view of the opinions expressed by the various local Committees, and their executive officials, to whom they were submitted. It is hoped that the system now adopted may meet the requirements of the majority of the candidates.

Swedish has been added to the list of subjects in Stages II. and III., and the examination in Danish will in future be in Danish and Norwegian.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments of Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the Programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

USES OF ELECTRICITY IN MINES.

By Henry Willock Ravenshaw,
Assoc.Mem.Inst.C.E., Mem.Fed.Inst.M.E.

Lecture II.—Delivered May 22nd, 1905.

In my last lecture, I went into the question of electrical transmission of power. I will now take a few of the minor applications, some of which such as signalling, are almost of equal importance.

Electric Lighting.—The electric lighting of a colliery is generally independent of the power plant, and, as a rule, a continuous service is maintained. A pressure of 220 volts direct current is usually employed, and the shaft cables (in some cases 600 to 1,000 yards long) have to be of ample section to prevent an undue drop of pressure. As a man is required to attend to the ventilating fan engine night and day, the electric lighting dynamos are frequently so placed that he can look after them.

Owing to the large amount of dust from the surface works, and the general dampness of the atmosphere due to steam from the exhaust of the winding engines, it is very difficult to maintain a good insulation resistance on the surface. It is, therefore, excellent practice to have a separate dynamo for supplying the underground lighting. It is a curious fact that even in a damp mine it is easier to maintain a good insulation underground than on the surface. Where motors are used at a considerable distance from the pit bottom, it is very convenient to light their engine rooms and the adjacent roadways by lamps, in series, on the power mains. Electric accumulator lamps are sometimes employed, but they are not very largely used, the extra weight and first cost being against them.

For officials and inspections, small dry battery hand lamps are very convenient as an auxiliary to the ordinary safety lamp. Electricity has also been applied to the lighting of the ordinary oil safety lamps, and Messrs. Johnson, Clapham, and Morris have kindly lent me a lamp-lighter which shows the expedition with which a number of lamps can be lighted. The arrangement consists of a single cell accumulator, and each lamp has a short piece of wire close to the wick connected to studs which can make contact with the battery circuit. When the current passes through the wire it becomes incandescent, and lights the lamp. When the men are going down the pit, a very large number of lamps have to be lighted for them, and as they all have to be sealed and examined a great deal of oil is saved where an electrical arrangement can be used to light each lamp as it is issued.

Signalling.—The earliest forms of signalling were by word of mouth, and in some pits in Belgium this custom survives in the form of a short prayer for their safety, which is sung out by the banksmen when men are descending. In some parts of Durham, the banksman sings out, "throw nought down." The somewhat primitive "rapper," where a hammer is lifted by a wire, and allowed to drop on a piece of loose iron plate, is still largely used, but for long distances these have to be worked by relays of men, and the work is very arduous. Electric signalling bells have now become very popular, and in some cases as many as twenty primary cells are used on a circuit. In order to prevent danger from sparking at the contacts, the new Home Office rules limit the pressure on signalling circuits to fifteen volts in fiery mines. The bells and keys are generally fitted so as to be dust and damp tight. On roads where mechanical haulage is employed, two bare wires are stretched overhead at such a distance that they can be pinched together with the hand. These wires are connected to a bell circuit so that signals can be transmitted from any point on the roadway to the engineman. The cost of primary batteries in a large colliery is considerable, and amounts to as much as £80 a year for material alone. Telephones are largely used, but it is remarkable that until quite recently a large number of collieries were not fitted with them.

Shot Firing.—Two systems are in general use for electrically igniting the fuses, namely, the low tension and the high tension. In both cases magneto generators are generally used which are turned by hand, but, in the case of shaft sinking, shots are frequently fired from the lighting circuits. In the case of the low tension, the current heats a fine platinum wire which fires the detonating charge. A pressure of only a few volts is employed, and when several shots are to be fired the fuses are arranged in series. With this system it is possible to test for continuity of circuit, but this advantage is somewhat discounted by the fact that it is practically impossible to dis-

tinguish between a complete circuit and a short circuit. Batteries, either primary or secondary, are sometimes used for low-tension fuses. With high-tension ignition the points are a short distance apart, and they are generally coated with conducting and inflammable chemicals. A pressure only of from 30 to 150 volts is required, and it is probable that an arc is actually formed. In this system the fuses are arranged in parallel. High-tension fuses are somewhat cheaper than low tension, and appear to be the more popular with the officials who have to use them.

Alternating and Direct Currents.—Both direct and alternating currents have been largely used in mines with success, but experience points to the fact that the alternating system is the more suitable. Where large powers are required, the difficulty in breaking heavy direct currents in enclosed boxes is very great; oil switches cannot safely be employed owing to the quick break causing a heavy rise of potential in the circuit, and the same objections apply to magnetic blowouts.

With alternating currents oil switches can be safely used, and this one point alone is sufficient to give that system a great advantage. The absence of brushes and the possibility of using squirrel cage rotors is also an advantage, although the modern motor gives very little trouble at the commutator.

High pressures have no great advantages for use inbye, as the distance from the distributing centre is not, as a rule, more than two to three miles, or well within the economical limit for a pressure of 500 volts.

Precautions.—It is of absolute importance that the safety of the mine is ensured, and a very long step towards immunity from accident is to put down a first rate plant in the first place.

In a colliery where capital expenditure is of necessity kept low, there is a temptation to buy in the cheapest market. Electrical machinery, however, has been reduced in price to a remarkable extent, and there is no possible excuse for those responsible risking the lives of men in their charge by purchasing in the very lowest market. I speak strongly on this question as I have seen a great deal of dangerous rubbish in use, and I am glad to say that the report of the Home Office Committee made a very strong point of this question.

Next to a good plant, proper maintenance is of the greatest importance, the insulation of every detail being properly maintained. All plants, particularly in safety lamp mines, should be systematically and independently inspected several times a year. In safety lamp mines motors should always be placed in the intake air, and in my own practice, whenever possible, the motor rooms are used as lamp-lighting stations, so that special precautions are taken to keep them free from gas. The question of enclosed motors is an important one, and the experiments made by Mr. W. E. Garforth, and described by him in his evidence before the Home Office Committee, appears to me to cover the whole ground. The experiments are fully described, with eleven fine photographs, in the minutes of evidence taken before the committee, and the conclusions arrived at are as follows:

It is possible to run an entirely enclosed motor, the covers being machine faced and efficiently gas tight, in an explosive mixture for one hour without ignition. An unenclosed direct current motor will ignite gas. If an enclosed motor is surrounded for 14 hours by an explosive mixture the gas may diffuse into the case and cause an internal explosion. The internal explosion above-mentioned will not of necessity ignite the external mixture.

Home Office Committee and Rules.—In 1902 a committee of six members was appointed by H.M. Principal Secretary of State of the Home Department to inquire into the use of electricity in coal and metalliferous mines, and evidence was first taken on November 26th, 1902; 6,958 questions were put to the 57 witnesses who were invited to give evidence. A report was issued on January 19th, 1904, including a code of rules which it was suggested should be adopted. Special rules, which differed considerably from those originally suggested, were issued in February, 1905, by the Home Office, and these are now in force in this country.

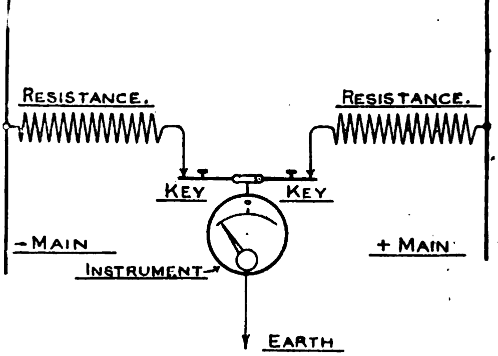
Although any new regulations are sure to cause a certain amount of hardship on those who come within their sphere, colliery owners having properly-installed plants have been put to very little expense in complying with the new rules. Rule 6, Section III., which requires that leather or other flexible material shall be used for suspending cables underground, is the only one which is likely to cause any real hardship. This rule is of somewhat "cast-iron" character, as hundreds of miles of cables are already fixed up by cleats, and in many places, especially where there is very little room, competent colliery

managers are of opinion that a flexible suspension is not suitable.

I have already pointed out the importance of the proper maintenance of insulation, and the new rules require that this point should be specially safeguarded. Rules 6 and 7, Section I., require that the leakage current shall not exceed one-thousandth of the maximum supply current, and earth detectors are required to be connected up to show immediately any defect in the insulation of the system. The readings from these instruments have to be recorded daily.

The leakage current permitted does not err on the side of stringency, as in a properly-maintained plant it should not exceed one ten-thousandth. The detector specified has presented a difficult problem to the manufacturers, but they have risen to the occasion and produced instruments which comply fairly well with the specification. None of these instruments actually comply with the letter of the rule, but they usually show when there is a serious leak, and by actuating a small switch the pole can be located and a fairly accurate measurement obtained. The simplest arrangement for direct currents is perhaps that shown in Fig. 10, where a high resistance

FIG. 10.



is connected across from positive to negative pole, and the centre connected to earth through a sensitive polarised instrument. To obtain the insulation resistance one side or the other of the resistance is disconnected, and the deflections noted. To obtain an accurate result, a calculation must be made from the two readings, or, better still, a table can be used from which the results can be read.

This system does not accurately show leakage in all cases, without a certain amount of manipulation, as for instance, where the insulation resistance of both poles, whether high or low, is equal, no deflection is shown. If properly used, however, the arrangement is a great safeguard against mishap. For three-phase circuits, Mr. Raphael proposes to make a star connection between the phases through high resistances, connecting the centre through an instrument to earth. By disconnecting the phases in rotation the earth can be located. This instrument has defects somewhat similar to that for direct currents, but they are both in advance of their predecessors. The following rules may be noted:—Where safety lamps are required, the pressure is limited to 650 volts, and under. Telephone communication has to be maintained between the surface and the distribution centre. Open motors are allowed in properly ventilated places. The pressure for signalling circuits is limited to 15 volts. (There are 56 rules divided in eleven sections.)

Costs.—The questions of capital expenditure and running cost are of the greatest importance, and it may be safely said that where proper economy has not been exercised in putting down a plant, there will be likely to be found heavy working costs and unreliable running.

For colliery work the plant must be of the highest quality but simplicity of design is of the greatest importance. Where steam engines are used an excellent electric generating plant, suitable for a works or colliery, can be put down for £22 per kilowatt output. A gas engine plant using coke or anthracite would cost £24 per kilowatt, and if coke oven gas is used £22 per kilowatt. An exhaust steam plant of the Rateau type would probably cost from £18 to £20 per kilowatt.

These figures are taken from actual practice and make no allowance for spare plant. A margin of about 20 per cent. is generally allowed for spares. Depreciation, and interest on capital expended, are items that are of the greatest importance in calculating costs, and it is an astonishing fact that until quite recently the question of depreciation has been practically ignored by many of the large electricity supply undertakings. Municipal authorities have actually borrowed money to be repaid in from 30 to 40 years to purchase machinery that has become obsolete and been sold for practically scrap price in less than a third of that time.

In commercial undertakings of high standing this question is always taken into careful consideration, and true costs cannot be obtained unless at least 5 per cent. be allowed for depreciation and 5 per cent. for interest on capital. Where there is a low power factor,

which is usually the case with a public supply, these items will be found to exceed considerably the total working costs, but, in a mine, where the first costs of a generating and distributing plant are comparatively low and a good load factor is generally maintained, interest and depreciation should not exceed 0·25 penny per unit.

With regard to coal consumption it must be remembered that although coal may be cheap, boilers cost money to put down and maintain. I have gone rather thoroughly into this question, and I find that, on an average, for every ton of coal burnt, the costs for labour, boiler repairs, depreciation and interest on capital, amount to at least 2s. 6d., consequently, even if the coal cost nothing, a ton saved per day would mean a saving of at least £40 per annum. In large collieries from 50 to 80 tons a day are burnt under the boilers, and in many cases it is practically certain that this consumption could be reduced by one half.

FIG. 11.

PEEBLES ILGNER FLYWHEEL COMPENSATOR (Bruce Peebles and Co., Ltd.).

The following consumptions if obtained all the year round are not likely to be improved on with a 200 kilowatt plant working 16 hours a day:—Steam engines, 5 lbs. per kilowatt

FIG. 12.

ELECTRIC DIP PUMP IN HEADING (3 ft. 6 in. high).

FIG. 13.

ELECTRIC LONGWALL CUTTER (J. Davis and Son, Ltd.)

gas engine with anthracite, 1·85 lbs. per kilowatt; gas engine with coke, 2·25 lbs. per kilowatt.

The costs with a good load factor should not exceed:—

Coal and boiler or producer charges	0·20d.	per unit.
Labour, stores, repairs	0·15d.	,,
Depreciation and interest	0·25d.	,,
	0·60d.	

With a plant of double the size, the costs can be reduced to 0·5d. per unit. When it is considered that with a 200 kilowatt plant working for ten hours a day, a saving of 1-10th of a penny per unit means £250 per annum, the importance of economy is evident. The fact that the cost of electrical machinery has been enormously reduced in the last ten years, is of great advantage to power users, and has given an enormous impetus to electrical transmissions. A slow speed 40-h.p. motor which used to cost £220, can now be bought for £100 or about £2 10s. per h.p., a great contrast to high-class steam engines which cost about £5 per h.p.

In putting down an electrical power plant the cost of the generating station must be considered, but it is an interesting fact that where there are a good many motors working on variable loads the demand seldom exceeds one-half of their aggregate maximum capacity. For instance, a 500 horse-power dynamo will generally be sufficient to supply current to 1,000 horse-power of motors.

I am convinced that a colliery of fair size can generate electricity for its own use at a considerably lower rate than a public supply can afford to sell it at a profit, if a proper allowance is made for depreciation in both cases.

The history of this application hardly goes back further than twenty years, and I am glad to say that practically all the pioneers are still hard at work. Mr. Frank Brain, of Trafalgar Collieries, in the Forest of Dean, is probably the earliest pioneer, as he used electric signals as far back as 1866, and an electric pump in 1882. Most of the early work from 1885 to 1891 was done in this country by Messrs. Immisch, Scott and Mountain, and Goolden and Co., and I can recall the names of Messrs. L. and C. Atkinson, Selby Bigge, S. Corlett, M. Deacon, W. C. Mountain, and Albion Snell as being prominent workers in those days.

The advantages of the use of electricity in mines is in many cases obvious, and it is certain that as new collieries are opened out, and old ones reorganised, the electric motor will be almost universally used; in fact I feel fairly safe in saying that where compressed air has to be used the air compressors of the future will be electrically driven in the mine itself. With regard to winding, a great deal has to be done in devising simple and economical electrical methods before they are generally adopted, but it is more than likely that this class of plant will be of great importance in the future. Electrical driving is being almost universally adopted all over the world, for its all-round economy and convenience, and these advantages are being rapidly appreciated among mining engineers.

FIG. 14.

ELECTRIC BAR COAL CUTTER (Mavor and Coulson).

[Figs. 11, 12, 13, and 14 illustrate various applications described in the first Lecture.]

FROM CHENGTU TO THIBET.

Last year Mr. Alexander Hosie, His Majesty's Consul-General at Chengtu, was instructed to make a journey to the eastern frontier of Thibet, and his report upon it, now published as a Parliamentary Paper (China, No. 1, 1905), is an interesting description of an unknown country. The great highway connecting Chengtu with Lhassa passes westward through various cities, and across the upper waters of the Yang-tsze to the Ning-ching mountains, which at this point form the boundary line of Thibet and China, the distance by road from Chengtu to the frontier being about 600 miles, and to Lhassa 1,500. Mr. Hosie did not attempt to go beyond the frontier. Leaving Chengtu on the morning of the 28th July, 1904, he reached the frontier on September 16, so that it took him seven weeks to do the 600 miles. "There was perfect silence," he writes, "as I went up to the boundary stone which marks the frontier of the two countries, but I could see a fixed determination on the part of the troops to resist any attempt on my part to cross into Thibet. The boundary stone which stands some 30 yards to the north-east of an obo by the road side is a well worn, four-sided pillar of sandstone, about 3 feet in height, each side measuring some 18 inches. There was no inscription on the stone, and when unthinkingly I made a movement to look for writing on the Thibetan side the Chinese officials at once stepped in front of me and barred the road to Thibet." The road travelled by Mr. Hosie is that taken by the Chinese Imperial Residents for Thibet, who occupy several months on the journey; along it devout pilgrims, eager to look upon the face of the Dalai Lama, advance, some by continuous genuflections and prostrations taking years to reach their goal; and over it dash Imperial couriers who, by travelling night and day, are able to carry messages from Lhassa to the nearest telegraph office at Ta-chien-lu, some 1,300 miles, in less than twenty days.

The journey was monotonous, and the people uninteresting. Most of the men become priests, of a sort. "In a land," writes Mr. Hosie, "where each family devotes one or two of its sons to the priesthood, female infanticide is unheard of, and woman is a very valuable asset. She milks the cattle before they are sent out to graze in the early morning, and on their return in the evening. This done, she slings the empty wooden water butt (some 2½ feet long by 18 inches or more in diameter) on her back, and runs off to the nearest stream for the day's water supply. Filling the butt by means of a birch-bark baler, she balances it on her back, the bottom resting on an adjustable pad of cloth or fibre, and the upper part kept in position by a rope of raw hide thong encircling butt and chest. This visit to the stream she repeats several times during the morning, storing the supply in a large wooden vat. She makes the butter, an important article of food in a country whose altitude defies the growth of oil plants, and where the difficulties and cost of transport are prohibitive, in the wooden churns of our forefathers without, however, that care and cleanliness which they bestowed upon it. She prepares the food, she weaves the cloth, and she attends to the many other duties of the household, besides engaging when necessary in the usual outdoor work of the farm." The Thibetan women are not attractive. They wear the Litang forelock hanging down to the tip of the nose, and their hair is done up in numerous plaits which straggle down the back, but are hidden in the case of the widow and wife by an elaborate head-dress. Butter is their hair oil. Mr. Hosie joined a family at one of their meals, and took a minor part in its preparation. Husked barley is baked for a short time in a flat cooking-pot and then ground into flour in the usual stone mill worked by hand. The barley meal—called tsamba—is collected and placed in a hide bag. A handful of brick tea is thrown into a large copper cooking-pot narrowing slightly at the neck. A little cold water is poured into the pot, and as soon as it comes to the boil more cold water is added. When this in turn boils the contents are removed by copper ladles and passed through a conical strainer into a small churn wherein some butter has been dropped, and a little salt is added. The tea and butter are churned together, and the compound ladled out and passed through a strainer into a large copper teapot, whence it is poured into the usual wooden cups. "We all sat on the floor," says Mr. Hosie, "holding the cups in our hands. Each sipped about a third of the buttered tea, and then took a handful of tsamba from the hide bag and placed it in the cup, kneading the whole into a dough with the fingers. There are no spoons, forks, or chopsticks, and pieces of the warm dough are simply carried by hand to mouth. This is the ordinary Thibetan meal, the cups being replenished at will." Occasionally beef or mutton is eaten in the early morning or the evening; it is sometimes eaten raw. So with vegetables such as turnips, they are eaten uncooked, and a favourite tit-bit is the green-husked grains of barley, which are tossed into the mouth with much dexterity.

The country between Ta-chien-lu and the Thibetan frontier is a land of mountain, forest, valley, and river, rarely falling below an altitude of 11,000 feet above the sea. Grass and certain wild flowers seem to grow at any height, but the limit of cultivation of any kind is under 13,000 feet. In valleys between 12,000 and 13,000 feet barley, wheat, and oats, as well as small round turnips, are grown, but immediately that height is exceeded grass covers the land. Even when working cultivable areas the Thibetan seems to be a poor farmer. With his team of yak, or a couple of yak harnessed to his one-handled wooden plough, he does little more than scratch the surface of the ground, and he fails to warm and sufficiently enrich his fields with his abundant stable manure. The country is far more pastoral than agricultural. Tent life, with its horse-breeding and cattle and sheep raising, is more to the taste of the people than the cultivation of

fields. Mr. Hosie says that anyone who has seen Highland cattle will, by imagining clumsy animals about double the size, have a very fair idea of what yak are. If he will further imagine that they are nearly all black, that their black horns have a simple semicircular curve, and that they have long, very bushy tails, his idea will be still nearer the mark. They are slow, plodding animals, but well fitted for work on the mountain roads. Yak milk is the milk of the country and provides butter and curds. The dzo, or Chinese pien niu, the cross between the yak and the ox, is also used as a pack animal, and is noted for its strength and endurance. It is, however, much rarer than the yak.

The religion of the people is little more than mechanical. They have their lamaseries, where, or in the street, they may engage priests to perform their religious duties—chant the sacred books, beat drums, and turn prayer cylinders or wheels. The latter are always turned from right to left, whether by hand, water, or air. They vary in size. In the house of a headman Mr. Hosie counted over twenty let upright into different walls. They were made of raw hide from 3 feet to a foot in length, and from a foot to several inches in diameter. They were filled with written or printed prayers, and the turn of a cylinder by hand is equivalent to uttering a prayer. Small cylinders for hand use are made of silver, copper, and white metal, some of them of beautiful workmanship. Mr. Hosie found it difficult to purchase specimens, the reason given being that they are supposed to be cremated with their owners. Cylinders turned by water-power are common, and they are sometimes fitted to small windmills inserted in the apertures, which do duty for chimneys on the house-tops. The draught is sufficient to turn mill and cylinder. On the road members of Mr. Hosie's escort were always muttering what he took to be prayers, and even the women carrying water were usually reciting in a low voice something only intelligible to themselves. The obo have also a religious significance. They are of two kinds. On the mountain passes they consist of mere conical heaps of stones thrown by passing travellers and decked with prayer flags on their summits. Each stone is a thank offering to the gods for safety. In the villages they were more elaborate, usually oblong, and built of stones, or alternate layers of turf and stone, some three feet or less in height, shaped like a sloping roof, with slabs of slate or marble, inscribed with whole prayers or the single letters making up the invocation, *Om mani Padmé Hum*. Rising from the centre of this heap of prayers there is usually a rude carved pole some 6 feet high, but no prayer flag, for the prayers carved in the lamaseries and sold to the people lie below. The letters, sometimes accompanied with figures of animals, fishes, snakes, and frogs, are common, and are not unfrequently painted in various colours. Burial, cremation, exposure to the birds of the air, and throwing into the river are the methods employed in disposing of the dead in different parts of the country. Education is confined to the lamaseries, and even then few of the priests can do more than read their sacred literature, and that with the greatest difficulty. Writing is an art which few have learned.

Brick tea is the great import. The total annual quantity of brick tea carried to Ta-chien-lu for consumption to the west of the city is approximately 11,377,333 lbs., of the value of 948,591 taels. The principal export from Thibet is musk. The pods, with an inch-wide fringe of skin and hair, are brought to Ta-chien-lu, where they are trimmed, cleaned, and made ready for the Chinese or foreign market. The fringe of skin and hair is removed by scissors, and, in the case of musk intended for the Japanese market, the hair round the trimmed pod is carefully singed. There are several tests for adulteration. If the smell is not satisfactory, and any doubt exists as to the genuineness of the contents, a small sharp scoop is thrust into the pod and a few grains extracted. The grains are put in a cup of water. If they remain granular the musk is genuine; if they melt it is false. Another test is to place a few grains on a live piece of charcoal. If they melt and bubble on the red surface, the musk is good; if they at once harden and become cinder, the musk is adulterated. The trimmed and clean musk pods are valued at from 15 taels to 16 taels per Chinese ounce (1⅓ oz. English), and the total amount annually cleaned at Ta-chien-lu for the Chinese and foreign market is estimated at 1,100 to 1,200 catties of the value of 300,000 taels. The banks of the Li Chu, in the Litang Plain, are very rich in gold, but the lamas of the Litang lamasery are opposed to, and prevent its exploitation. Thibet and the border lands are famed for the production of certain medicines, animal and vegetable, including the mixture of animal and vegetable, known as *Condiceps sinensis*. Raw borax comes from Thibet, and is converted into pure borax at Ta-chien-lu. Furs are represented by the fox and the lynx. The total of exports and imports are valued at only 1,722,591 taels; 669,100 taels representing the exports from Thibet to China, musk accounting for 300,000 taels, and gold dust for 192,000.

THE HIGHER EDUCATION OF WOMEN IN SOUTH AFRICA.*

Limitations of the Term.—In almost any country, and assuredly in any other land where English is the language of the State and of schools, the connotation of the term, "higher education," would be strictly limited to college and university work above the grade of matriculation. But in South Africa, a comparatively new country, the term may be allowed a somewhat broader and more general significance, so that it may be understood as including—(1) Secondary

* Paper read by Miss E. M. Clark before Section L of the British Association at Cape Town.

or high-school education; (2) normal or training-school education; (3) collegiate or university education. From the outset certain peculiarities characteristic of the country should be borne in mind: (1) the differences of standard, nationality considered, as among Colonial Dutch, Colonial English, and real Europeans; (2) the differences of standard, locally considered, as between town and country education; (3) the popularly accepted differences of standard for boys and girls.

Provision for such Education.—The number of schools having the technical right to the name "High School" is comparatively small; but all of the "A 1" public schools are doing some work of this grade, while many of them are offering instruction in all the highest standards, including matriculation. Statistics for 1904 report 2,331 pupils in High School grades, without specifying as to sex, though here it is safe to say that the girls are in the minority. . . Very different in this respect is the case with the three "European" Training Schools for pupil-teachers and others, which report a very striking majority of female students. Of these one is in the eastern division, and two are in the western. The specific object of these three institutions is that of giving instruction in the principles and methods which lie at the base of successful teaching: 284 students represent the enrolment for last year. . . In four institutions of College grade, preparing for the Cape University examinations, young women are now following the prescribed courses of study; the total registration, however, is not over fifty, and a very large proportion of these women students are in the intermediate class.

Changes in Standard.—Forty-five years ago there existed in the whole country only one large school for girls; twenty-five years ago at least six had been founded, and were in successful operation. No one of these, however, at that time was doing anything like college work, nor was matriculation then regarded as a *school* examination. Reading, writing, elementary arithmetic, with "accomplishments," had been up to that time considered all that was necessary for a girl to know for her own good, while there existed little or no conception of training or education for the sake of imparting knowledge to others. . . . The development has been slow but steady. The grade-standard has advanced, as has also the generally accepted standard of public opinion, in both city and rural communities. One very important element in this advance, so far as the education of women is concerned, has been the growing necessity for self-support, with the increasing strictness of requirement on the part of the Department of Education, a strictness which has been applied in due proportion to schools of all grades. According to the official report of the Superintendent-General for 1904, the percentage of "female teachers in the seven most important classes of schools," varies from 49·13 to 89·33, an indication of a great change during the quarter of a century in the general attitude toward the question of the right of young women to teach and to be taught.

The University System.—The University of the Cape of Good Hope is exclusively an examining body, having the right to grant academic degrees. Five teaching institutions or colleges prepare students for the examinations leading to the grades—Intermediate, B.A., and M.A. There has never been on the part of the University any discrimination of sex in the matter of eligibility to the examinations given, or the degrees conferred. In most of the Colleges co-education exists, while during the past few years several scholarships based on competitive examinations have been taken by women.

The Situation and the Outlook.—With reference to the future, even the immediate future, several important topics suggest themselves as worthy of consideration—(1) the actual supply of teachers in relationship to the demand; (2) the advantages and disadvantages of bringing in trained educators from England and elsewhere; (3) the possibilities of partial self-support for women students; (4) a study of the methods of higher education here and in other lands; (5) suggestions as to possible future developments, regard being had to the special conditions of the country. . . . These points, however, can be only named, not developed, in so brief an outline.

Causes of Small Increase.—The slow advance in the number of women students registered by the Colleges of this country is usually attributed to one of two causes: (1) lack of interest; (2) lack of means. Into the reason first named may be read the meaning—lack of desire for the advantages offered, or of appreciation of their real value; several good authorities in the educational world regard this as the fundamental reason. Others, however, are equally sure that the expense of a College course, or even the immediate necessity for bread-winning, lies at the root of the fact that now, nearly twenty years after the granting of the first Cape University degree of B.A. to a woman, there are throughout the country fewer than fifty women students preparing for the University examinations. In other lands, where the paternal governments are less fartherly than here, much more is done in the way of self-support by undergraduates of both sexes, even while pursuing their studies. Yet it must be acknowledged that the difficulties are greater here than in those countries where a student who has "worked her way" from matriculation to B.A. is not an anomaly.

The End—the Means and the Woman.—The higher education of women is a comparatively new factor in the growth of this country, and up to the present there has been very little conception of such education for its own sake, or for any other purpose than as a means to an end—the end being an academic degree which will open the way to a better position in the teaching profession than it would otherwise be possible to obtain. One would expect this to be true of the advanced classes in the training schools, but it is almost

equally the case in the Intermediate and B.A. grades of the Colleges under the University. Whereas, in England, to some extent, and in the States to a much more noticeable degree, girls go to College for the sake of the social life, or through pure interest in some special line of study; or even, in some families, as a matter of course, the situation in this country is as yet more nearly akin to that of Germany or Switzerland, where the woman student is still in some degree a *rara avis*, therefore more or less conscious of herself, her position, and the serious phases of collegiate life. . . . The higher education of women in this country has an immediate and a present interest, not only because of what has been and is, but also because of the real need that exists, and because of the unlimited possibilities of future development.

MANUAL WORK IN SECONDARY SCHOOLS.

The following memorandum has been issued by the Board of Education, Whitehall:—

For the ordinary course under Section 4 of the Regulations, the Board have not laid down any strict definition of the nature of the manual work for which provision is to be made, nor have they prescribed the amount of time that should be given to it. While, therefore, a large discretion is left to schools in the matter, it is desirable to indicate what kind and amount of work will be regarded as normally satisfying the requirements of this Regulation.

The object of the Board is to ensure that scholars passing through the course receive some definite and systematic instruction of a progressive kind which will train them to observe accurately, to use their fingers skilfully, and to exercise forethought and intelligence in the use of means towards definite ends in production.

In a school where there are classes below those taking the course, provision will already have been made in these classes, in accordance with Section 2 of the Regulations, for work to develop accuracy of observation and skill of hand. For this purpose no special work-room or elaborate apparatus is needed. Among suitable subjects may be named plaiting and weaving (for quite young children), basket work, modelling in clay or plasticine, and cardboard work in connection with geometrical drawing.

For scholars in the course this kind of instruction ought to be further developed. For boys a course in wood-work (and, where this can conveniently be added, in metal-work also) is educationally the most useful. Any course in wood or metal-work ought to be thorough. True and accurate work is absolutely essential for the object in view, and this cannot be secured without a bench and proper tools. Slovenly teaching must, above all things, be avoided. Knowledge of and skill in the use of a few good tools is essential. A workshop fitted with benches and sufficient apparatus is desirable in all well-equipped schools. Almost any room that is well lighted and sufficiently warmed and ventilated may be used for this purpose. The general indirect educational value of doing work under orderly conditions and with proper equipment is very great. But this special provision will not be insisted upon in all cases, and the Board will have regard to the circumstances of each school in determining what kind of provision short of this it may be reasonably required to make. Of the other subjects named above, clay modelling in connection with plenty of free drawing is probably the best suited for scholars over twelve. It is equally applicable to boys and girls.

It is not required that manual work shall form part of the instruction in each term or even in each year of the course. It may often be desirable to take it for only one term in the school-year, and to give more time and attention to it then. Such an arrangement, with careful planning of hours, will enable even a small workshop to be used by large numbers of scholars in the course of the year. It will also allow of the instruction being given in periods of sufficient length. For wood or iron-work in particular, a period of two hours, including the time given to the preliminary drawings, is found to be necessary in order to produce the best educational results. With such a period, taken once a week throughout a term, good and solid progress can be made. For other kinds of manual work shorter periods may be found sufficient. In all cases the educational value of the work is largely increased by its being so arranged as to require some continuous and concentrated effort from the scholars.

For girls it is provided that the course shall include instruction in practical housewifery with or without other manual work. Some kinds of needlework, with the subsidiary processes of designing, cutting-out, &c., give good training to both hand and eye; and the same is true of most other instruction which comes under the head of Practical Housewifery, if planned with special regard to that end. Gardening, for both boys and girls, where facilities for it exist, also gives this training together with healthy out-of-door exercise.

In all these cases it should be borne in mind that the training sought is of a practical as well as an intellectual and moral nature, and that the work done should therefore not confine itself to exercises in method, but should be directed concurrently, and almost from the first, towards the production of actual things. It should also be understood that the subjects mentioned here do not profess to be an exhaustive list of the kinds of Manual Work suitable for Secondary Schools. Any well-planned course of progressive instruction which, in the opinion of the School Authorities, will carry out the general object aimed at may be submitted for approval, and will not be disallowed unless it clearly fails, through insufficient amount or inferior quality, to meet the object which, as stated above, the Board have in view in the Regulation.

HOME INDUSTRIES.

Mother-of-Pearl Buttons.—How trade may be lost, or diverted, is shown by what has befallen mother-of-pearl shell. Twenty years ago Tahiti black-edged shells fetched a comparatively small price in London. Then prices augmented and remained fairly firm at renumerative rates until 1903 when best, clean, sound shells fetched as much as £200 to £220 per ton, whilst second and third grades brought about £160 and £110 respectively. For ten years previous to 1903 the annual export of shell from Tahiti had averaged about 400 tons, the yearly output varying from 550 to 290 tons according to the productiveness of the lagoons open to divers. To all appearance, therefore, the demand for Tahitian shells had become steady. Then came a revolving storm of great violence causing heavy seas to sweep over certain of the low-lying atolls of the Paumoto group. Exaggerated descriptions of the catastrophe, and of the assured destruction of the shell beds, were immediately put into circulation, with the result that holders of shell in London raised prices, and, thereupon, in anticipation of a future dearth of black-edged shells in consequence of the disaster, button manufacturers, and those responsible for the fashions in dress, decided to change the mode from buttons of mother-of-pearl to those of metal, or of other suitable material. Meanwhile the authorities at Tahiti stimulated the output of shells at the Paumoto Islands by throwing open most of the best lagoons in that region, and by sanctioning the employment of diving machines, with the result that 660 tons of shell were exported in 1904, an over-production which, combined with the decreased demand following the change in fashions, has diminished the price of Tahitian shells in the London market to practically one-half what it was three years ago. Mr. Consul Simons, from whose report (No. 3493, Annual Series) the above figures are taken, says that the authorities at Tahiti stopped all diving operations at the shell islands from October 1, 1904, to February 1, 1905, and extended this prohibition to diving machines to May 1, 1905, precautions that should restrain within reasonable bounds the output for 1905.

Motor Omnibuses.—In their report on the means of locomotion and transport in London the Royal Commission, recently sitting, expressed the opinion that whilst motor 'buses are likely to practically supersede horse omnibuses, "and thus remove from the streets, greatly to the public advantage, a form of vehicle which, although it has been of great public utility, is now one of the principal causes of congestion in many streets," tramways will continue to be the most efficient and cheapest means of street conveyance. However that may be the motor omnibuses are making rapid headway. Three new motor omnibuses are being delivered to the London Motor Omnibus Company every week; the London General Omnibus Company have commenced a new service from Cricklewood to the Law Courts; other companies are opening up other routes, and now the experiment of a motor service to Brighton has began. The journey of fifty miles is to take something less than four hours, and it is expected that what may be called the intermediate service will be a very profitable part of the undertaking. It is too soon as yet to say whether the motor omnibuses can compete successfully for long distances with the railways, but that they will have an immense and beneficial effect in pushing residential London further into the country can hardly be doubted.

The Hop Crop.—Reference was made in the last number of the *Journal* to the acreage in hops over a series of years to 1904. The preliminary statement for the year 1905 of the Agricultural Returns of Great Britain has since been published, and shows that the acreage under hops this year is slightly in excess of that of 1904—48,968 acres as against 47,799 acres last year, an increase of 1,169 acres. The only hop-growing counties that do not show an increase in acreage under cultivation this year are Surrey and Salop, but the decrease is insignificant, in the one case 34 acres and in the other 5. The hop crop of the present year promises to be one of the largest of recent years, but the low temperature and wet weather of last week may have injured to some extent the quality. As was pointed out in the last issue of the *Journal*, the fluctuation in the yield of hops is very great, and the acreage under cultivation gives little indication of the quantity of hops produced. It is stated on authority that, so far as the English crop is concerned, there is not a bad district this year, and that there will be sufficient for all requirements without any importations.

Agriculture in Scotland.—In *The Times* of August 29th there is an interesting letter from Mr. J. Boyd Kinnear on the exodus from the country side. Mr. Kinnear says it is not visible across the border. There the labourers are content with village life because they are paid and housed well, and farmers thrive because they are given a free hand and treated fairly by their landlords. Without touching upon controversial matter it may be said that the wages of labourers are generally good north of the Tweed, but when Mr. Kinnear says that "speaking generally the rates are about 20s. a week with free cottage and garden," he does not quite agree with the official figures as found in the Abstract of Labour Statistics of the United Kingdom, 1902-1904 (Cd. 2491) In this return the average wages in every county of Scotland is given, and the highest wages paid in cash, not to ordinary labourers, but to shepherds, is 18s. 6d. in Linlithgow, the next being 17s. 11d. in Haddington. In Berwick the shepherds cash wage is only 14s. 4d., but allowances in kind bring it up to 21s. 7d. The highest wages paid in the United Kingdom to the ordinary labourer are in Northumberland and Durham, where he gets in the one county 19s. 4d. in

cash and allowances in kind that bring it up to 21s. 7d., and in the other 20s. in cash, with allowances bringing it up to 22s. 2d.

The Growth of Grass Land.—Mr. Kinnear goes on to say that "south of Northumberland the traveller sees rare fields of corn or roots, but field after field of grass (mostly poor) showing by its ridge and furrows that it had once been grain. To the north of that line the picture is reversed. With stretches of waving corn or yellow stubble (much of it wheat), broken by the vivid green of turnips and swedes, with but an occasional enclosure of pasture." Here again the official figures hardly bear out Mr. Kinnear's description in its entirety. Turning to the Agricultural Statistics 1904 (Cd. 2504), it will be found that whilst the acreage under wheat in England has decreased some 55 per cent. since the agricultural position was at its best in the seventies, the shrinkage n Scotland has been 65 per cent. The decrease in swedes and turnips has been much less in Scotland than in England—about 10 per cent, as compared with 30—but the increase in grass land has been in both countries about 30 per cent. Of course in some counties the change is more marked than in others, but in all the official returns show it to have been very considerable.

The Bacon and Ham Industry.—The threatened dearness of bacon, consequent largely upon the shrinkage of imports from Denmark, and in a lesser degree from Ireland, invites inquiry as to why more pigs are not reared in the United Kingdom. Whilst population continues to increase, not so rapidly as in the past but still rapidly, the number of pigs in Great Britain is actually less than it was ten years ago. In 1895 the number was 2,884,431; the returns just published put the number for 1904 at 2,861,644. In the meantime, the price of imported bacon, although fluctuating rather widely, has on the whole increased. In 1895 it was at an average of 39·01 shillings per cwt., in 1904 it was 47·07. Now it is very much higher. The price of Irish, Wiltshire, and Danish green bacon, which in January was at 56s. per cwt., is now quoted at 74s. In Ireland as in England, the number of pigs has decreased. In 1904 they numbered 2,861,644, and this year only 2,424,919, whilst the imports of pigs from Ireland to this country which in 1900 amounted to 715,202, fell last year to 505,080, and may be expected to be much smaller in 1905. On the other hand the imports of bacon from abroad show unbroken growth during the last fifteen years. In 1890 the value of the bacon imported into the United Kingdom was £6,978,061, and of hams £2,869,115; in 1904 the value of the one import had risen to £12,832,142, and the other to £3,104,999, so that at the present time the country is buying bacon and ham from abroad to the value, in round figures, of £16,000,000 per annum. It seems strange that under these circumstances the supply of pigs in the United Kingdom instead of increasing largely should show diminution as compared with the numbers of ten years ago.

Butter, Cheese, Eggs.—It is the same with butter and margarine, with cheese, lard, eggs. The acreage under grass in the United Kingdom has increased from 26,698,739 acres in 1889 to 28,693,305 in 1904, and it might have been expected that the home population would have been less dependent than in the past upon importation of these food articles. But the value of the butter imported has risen from £8,010,374 in 1887 to £21,117,162 in 1904; of cheese from £4,514,382 to £5,843,770; of condensed milk from £734,676 to £1,608,391; of eggs from £3,085,681 to £6,730,574; of lard from £1,604,243 to £3,342,389. Of course, population has increased considerably over this period of years, but if the proportional quantities per head of the population of the articles so imported are taken, it will be fouud that in most cases the proportion has steadily grown. For example, in 1887 the butter and margarine imported represented 8·5 lbs. per head of the population, in 1904 it had increased to 13·6, the proportion of foreign cheese consumed had increased from 5·6 lbs. to 6·7 per head, of lard from 2·8 to 4·8, and the number of eggs from 30 to 56.

The Rating of Machinery.—Reference was recently made in the *Journal* to the question of the rating of machinery, and since then the London Machinery League has prepared a statement that may be useful for reference. There can be no doubt that the Act of 1840 was intended to exempt machinery not attached to a building from being rated. That is admitted on all sides, and as the Act of 1840 is renewed every year by Parliament, it would seem reasonable to ask Parliament to give effect to its own Act. The present variation in the practice of the local authorities in construing the Act is due to contradictory judicial decisions, but it is obviously desirable that all districts should be treated alike, which is not the case at present. For example, Westminster does not tax machinery attached to the hereditament; Southwark and West Ham do, Manchester and Oldham do not, Newcastle does. This inequality of treatment was condemned by the Royal Commission of 1901, and would not be defended even by local authorities who consider that they are justified in rating.

Deep Sea Fishing.—Reference was recently made in the *Journal* to the growing consumption of fish in Germany, which is likely to be stimulated this year by the high price of meat. The German Government stimulates and protects the fishing industry in many ways. For example, all subventions for the building of new sailing vessels and for providing them with outfits of nets and gear, as well as all loans to fishermen and fishing companies, are made by the Government through the German Sea Fishing Association upon the representation of the latter. On such matters, as well as on research and kindred

objects, the Government expends annually about £20,000 for the benefit and encouragement of sea fishing, in addition to some £2,500 or £3,000 per annum towards the expenses of the Association. The owners of new smacks to be employed in herring fishing receive a building subvention of approximately £200 to £250, besides a further sum for the purchase of nets and gear; and although steamers receive no such subventions, those engaged in herring fishing are, nevertheless, furnished by the Government with a reserve fund for making good losses in nets, which fund cannot, however, be drawn upon without the Government sanction. This reserve fund is for steamers £240, and for sailing vessels £97. In order to make good the exceptionally heavy losses in nets and gear during 1904 the Government will, it is said, contribute £5,000, in addition to the £20,000 referred to above. A fishing museum was two years ago set up in the new municipal museum at Altona, and is already so great a success that it is to be considerably enlarged and improved, the Government contributing liberally to the funds for the purchase of models, &c. In November last year the Association offered to furnish German fishermen with good, reliable barometers at 2s. 6d. each. In three months 475 of the barometers had been issued, and, the reports upon them have everywhere been favourable.

OBITUARY.

GEORGE ATHELSTANE THRUPP.—Mr. Thrupp, the well-known coach-builder, and writer on coach-building, died on the 24th ult., at his house in Maida-vale, in his 84th year. He had been a Member of the Society of Arts since 1875, and in December 1876, he delivered a course of Cantor Lectures on the "History of the Art of Coach-building," which formed the groundwork of his subsequently published work on "The History of Coaches." He was also a frequent contributor to the *Journal* on subjects connected with carriage building and technical education. Mr. Thrupp was a past master of the Coach and Harness Makers' Company, and was founder of the Coachmakers' Benevolent Institution, of the Institute of British Carriage Manufacturers, and of Technical Schools for Coach Artisans. His business in Oxford-street was founded as far back as 1740.

GENERAL NOTES.

CAPETOWN PHOTOGRAPHIC EXHIBITION.—The Capetown Photographic Society will hold an exhibition at the City Hall, Cape Town, from Saturday, February 3rd, to Saturday, February 10th (inclusive). Entries close January 13th, 1906. Communications should be addressed to A. J. Fuller, Secretary, P.O., Box 470, Cape Town.

ROYAL SANITARY INSTITUTE.—The 40th course of lectures and demonstrations for sanitary officers arranged by the Sanitary Institute will commence on September 23rd, and continue until November 29th. The course comprises four lectures on elementary physics and chemistry in relation to water, soil, air and ventilation, and meteorology; and twenty-one lectures on public health statutes, the practical duties of a sanitary inspector, municipal hygiene or hygiene of communities, and building construction in its sanitary relations. Inspections and demonstrations are arranged in connection with the lectures, and include visits to public and private works illustrative of sanitary practice and administration. In the second part, seven lectures will be given on meat and food inspection. Further particulars can be obtained from the Secretary of the Institute, Margaret-street, W.

COTTON IN ST. VINCENT.—In his report upon the affairs of St. Vincent, dated 31st January, 1905 (Cd. 2238-23), the Administrator, Mr. Edward J. Cameron, speaks very favourably of the outlook for cotton cultivation in the island. The great agricultural feature of the year, he writes, has been the inauguration of the Sea Island cotton industry under the auspices and by the very active effort of the Imperial Department of Agriculture, under Sir David Morris, K.C.M.G. The results are certainly encouraging, "136 bales of excellent cotton realising from 4d. (this figure is for the upland quality) to 1s. 3½d. per lb. have been shipped from the colony since April last, and the present area in cultivation, from which the crop is being taken off at the time of writing, is approximately 1,471 acres. With these prices, which, moreover, leave a fair margin for a fall, the industry should certainly pay, and go some way in assisting to restore the colony's shattered prosperity." It is largely a question of price and labour.

SCHOOLS IN SAXONY.—In his report on the trade of Chemnitz and Saxony (No. 3342, Annual Series), Mr. Vice-Consul Felkin gives some interesting figures bearing upon education. In 1904 there were 739,076 school children in Saxony, 360,909 boys and 378,167 girls. The number was composed of 714,395 Lutherans, 21,163 Roman Catholics, and 3,518 other religions. For these, there were 12,196 teachers, making an average of 60 pupils to one teacher, but the rate varies considerably in different sections, being as much as 80 pupils to one teacher in some districts of Chemnitz and Zwickau, and as low as 40 in some districts of Dresden and Leipzic. The expenditure for national schools amounted to £1,715,000, which represents an average of £2 6s. for each pupil of the national schools. This compares with other parts of the Empire as follows: Berlin (average), £4 15s.; Austria, £2 8s.; Bavaria, £2 6s.; Mecklenburg-Strelitz, £1 13s.; Lippe-Detmold, £1 5s. It is interesting to note that the average age at which Saxon school teachers die is 46—a figure to which it has steadily declined since 1901, when the average age was 50.

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

TELEPHONY.

BY HERBERT LAWS WEBB.

Lecture I.—Delivered March 13th, 1905.

TELEPHONE INSTRUMENTS.

In attempting to cover in a course of four lectures a subject so full of technical detail as telephony, I realise that I am attempting a difficult task. Especially have I realised this during the past few weeks, when I have been engaged in extracting from a mass of information those points which I think would most interest an audience not composed wholly of telephone workers. Since one could give a paper or a lecture on any one of a thousand details in telephone engineering, I have been compelled to pick and choose, to eliminate and compress—making tabloids out of cart-loads.

I have divided the subject into the divisions which those engaged in the telephone business habitually apply. We divide a telephone system into three main parts—the equipment of the subscribers' stations, or the sub-station plant, the conduits, cables and wires joining those stations to the exchange, or the line plant, and the exchange switchboards and accessory appliances, or central office plant. I am devoting a lecture to each of these branches of the modern telephone system and one to the commercial side of the industry, the important questions of development and tariffs.

Let us take a brief glance at the rise and present position of the telephone business. The first commercial telephone exchange appeared in 1878—less than 27 years ago. At the present time there are not less than 5,000,000 telephones in use, probably, since exact statistics are difficult to collect, considerably over that figure; and at a moderate computation the telephone industry gives employment directly and indirectly to not less than a quarter of a million people. It draws on every branch of the electrical business, as, besides the many special appliances required, it needs conduits, cables, and wires in great variety, batteries, accumulators, dynamos and motors, and a host of general mechanical and electrical supplies. It also gives employment to a large number of general trades.

In scientific progress the development of telephony has been prodigious. Both the range and the scope of the telephone have enormously increased. In the early days the range of the telephone for commercial talking was a few miles. In the eighties telephone circuits of over a hundred miles were rare. To-day most of the capitals of continental Europe have direct telephonic intercommunication. In America, commercial talking is now done over distances of 2,000 miles. Ten years ago a city telephone system serving 10,000 telephones was the exception, and there were very few which exceeded that. To-day there are city telephone systems serving from 100,000 to 150,000 telephones. And so advanced are the methods of operating and the apparatus employed, that any two stations among those vast groups of telephones are put in communication with each other in an average time of about 30 seconds.

In volume of business done the telephone has long out-distanced the telegraph and is fast catching up the penny post. In this country the annual number of telephone communications is more than ten times the number of telegrams, and in America it is more than thirty times. In both countries the annual number of telephone calls is rapidly approaching the annual number of letters. Doubtless the telegraph will long continue to be used for very long distance messages and for messages where rapidity of communication is not important. But the speed, the directness and the completeness of the telephone message are so superlative that if everybody had the

telephone service, and knew how to use it, very few would send telegrams, and nobody would send a local telegram.

The Problem.

Let us for one moment go back to the dark ages, what I might call the *ante-Bellum* period, when the telephone spoke not for itself, but was only talked of. I hardly need to tell an audience like this that sounds as we know them have three distinct characteristics—pitch, or rate of vibration, loudness, or amplitude of vibration, and quality, or timbre, which is not so easy to define as it is to recognise. We habitually speak of sound vibrations as sound waves and represent them diagrammatically in wave form. The actual transmission of sounds through the air is by a to and fro vibration of the air particles, an alternate condensation and rarefaction. A simple note produces a rhythmical vibration, and if the loudness of the note increases or decreases the vibrations vary in amplitude, but not in rate, and, therefore, not in their general form. If quality is introduced, however, the form of the sound wave is modified, as quality is represented by extra vibrations, called overtones or partials, superimposed on the main vibrations. Quality is present in all sounds, and is what gives to musical sounds and to human voices their special characteristics, agreeable and otherwise. In musical instruments quality largely depends on the materials employed and the shape of the instrument. For example, we know that the same note on a piano or on a violin or on a clarionet has quite different sounds. Quality is pre-eminently present in the human voice. The variety among human voices is as great as the variety among human features, and different voices are as easily recognisable as different faces. We all carry voices in our memory, and know how easy it is to recognise with certainty a given voice at a distance. This great variety comes mainly from quality. Each voice has its own fundamental note, but it is quality, the overtones, from which such innumerable shades of sound result. Articulate speech is produced by the vibration of the vocal chords, and the quality is dependent on the tension on the chords and on the shape of the mouth cavity. By the tension we put on our vocal chords and by the movements we give to our tongue, teeth and lips, thus altering the shape of the mouth cavity or resonating chamber, we constantly vary the pitch and quality of the sounds we utter. It is an important feature of articulate speech, and one of great practical importance in telephony, that the clearness of speech does not in the least depend upon loudness, but solely upon pitch and quality. It is a common delusion, for example, that if one is not understood one must shout, and the Englishman abroad thinks to make himself understood by talking loudly in English. On the other hand we know that two people close together can converse in whispers, which shows plainly that clearness is not dependent on loudness, and not even so much on pitch as on quality.

Quality being the notable characteristic of the human voice, and quality introducing into sound vibrations innumerable extra vibrations, due to the partials or overtones, it follows that the sound waves of articulate speech are extremely complex in character. A simple note gives regular vibrations, while the sound waves due to articulate speech contain innumerable superimposed waves. The little superimposed waves are often at the rate of thousands per second.

This brief sketch of the acoustics of telephony shows us that the problem of the electrical transmission of speech was to transmit electrical waves identical in form with the sound waves. Every tiny wave must be reproduced, or the overtones, the all-important quality, would be lost, and the result would be only noises, not speech. The early thinkers and experimenters in telephony failed to recognise this vital principle. Borseul, in 1854, made a forecast of electric telephony, and described means for effecting it. But he apparently made no experiments, and his description speaks of making and breaking the current. By an interrupted current you can transmit pitch, but not quality; noises and notes, but not articulate speech.

Let us look for a moment at the means in the human system for receiving sounds, and see what guidance they give in telephony.

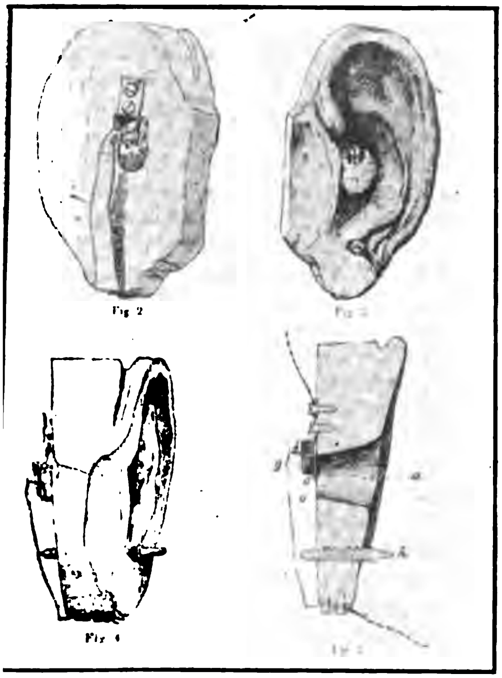
The human ear consists of an external ear, acting as a collector and resonating chamber, closed by a membrane or vibrating diaphragm to which is connected a chain of small bones, the mallet, anvil and stirrup. This chain of small bones forms an elastic system through which the vibrations taken up by the membrane from the surrounding air are transmitted to the labyrinth of auditory nerves, which convey them to the brain.

It was only natural that those who attempted to solve the problem of transmitting speech by electricity should study the mechanism of

the human ear and attempt to reproduce it. The human ear is clearly a transmitter or converter of sound waves into nerve impulses, and an electrical apparatus built on the same lines might transform sound vibrations into electrical impulses.

This was clearly the idea of Philip Reis, of Friedrichsdorf, who in the early sixties experimented extensively in electric telephony. In the early instruments of Reis are reproduced the membrane or vibrating diaphragm, the mallet and the anvil of the ear, the mallet and the anvil being interposed in the electric circuit.

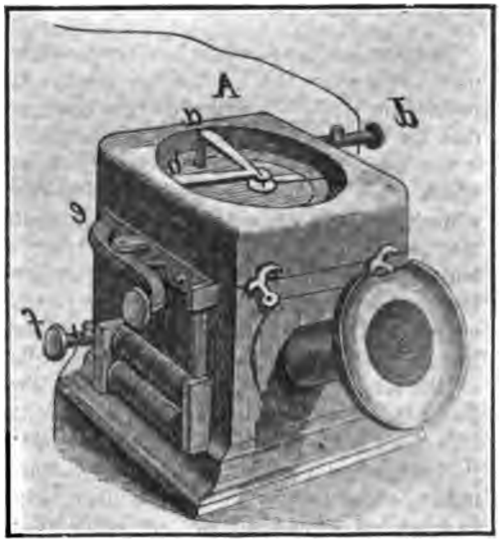
FIG. 1.



EARLY FORMS OF REIS TRANSMITTER.

Reis experimented for several years in telephony, but reached no definite results in the transmission of articulate speech, though the most finished form of his transmitter was of a type very similar to that of subsequent practical telephone transmitters. The fundamental difficulty with the Reis transmitter was that it was intended to make and break the circuit by the vibrations of the diaphragm. With a make and break transmitter the electrical waves change abruptly and do not follow the vibrations produced by articulate speech. With our present knowledge it is no difficult matter to make a Reis transmitter talk fairly well. Apparently Reis never made them talk more than a word or two at a time.

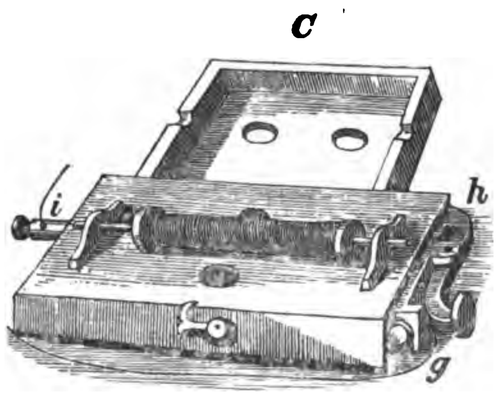
FIG. 2.



FINISHED FORM OF REIS TRANSMITTER.

The Reis receiver depended on the well-known Page effect, so-called because Professor Page, of Salem, discovered that a piece of iron, on being rapidly magnetised and demagnetised, gave out a sound. It is curious that Reis did not realise the necessity of using a diaphragm in his receivers; but all

FIG. 3.



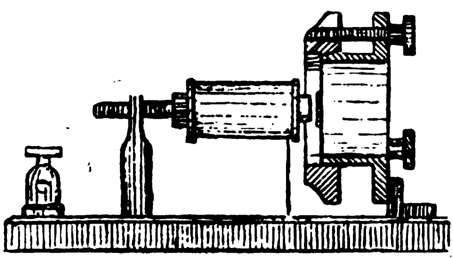
REIS RECEIVER.

his receivers were of this same form, a slender core surrounded by a coil. It seems probable that if Reis had equipped his receiver with a diaphragm he would have obtained results

which would have led to the discovery of the weak point of the transmitter, and enabled him to solve the problem. The experiments of Reis lasted seven or eight years but were never carried to a definite conclusion. In the early seventies Reis became an invalid and he died in 1874.

There was a lapse in telephonic experiments until Professor Bell definitely solved the problem in 1876. To Bell is due the discovery that for the transmission of articulate speech it was necessary to use an undulatory current which should exactly reproduce the voice vibrations. The means for doing this—the magnet, the coil and the iron diaphragm—had lain under the hands of all experimenters in electricity since the invention of the electro-magnet. The attainment of such great ends by such simple means has well been described as the very "hardihood of invention." Professor Bell thus described his discovery in the fifth claim of his patent of March 7th, 1876:—"The method of and apparatus for transmitting vocal sounds telegraphically, as herein described, *by causing electric undulations similar in form to the vibrations of the air* accompanying the said vocal or other sounds substantially as set forth."

FIG. 4.



EARLY BELL TELEPHONE.

In the earliest form of practical telephone transmitter devised by Bell the diaphragm was of membrane with a piece of iron attached to it at the centre. The iron armature, being vibrated by the diaphragm in front of the magnet poles, set up undulatory currents in the coils, which, circulating in the receiver coils, varied the magnetism of the receiver magnet, and vibrated the receiver diaphragm correspondingly. This simple apparatus transmitted articulate speech electrically, founded a new art, and gave rise to a new industry.

In the earliest telephone circuits magnet telephones were used both for transmitters and receivers. At first an electro-magnet was used in the transmitter, but this soon gave way to a permanent magnet; and the membrane diaphragm, which got slack in damp weather, was replaced by an iron diaphragm. The earliest form of receiver was a cylindrical iron box containing the magnet within and closed by the diaphragm.

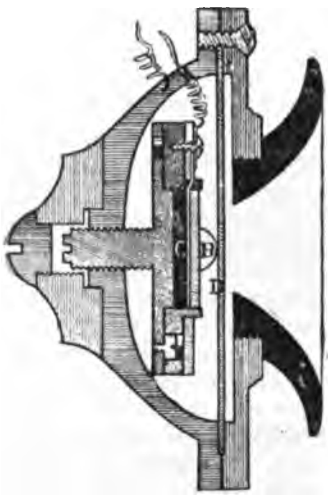
The late Professor Elisha Gray, the inventor of the harmonic telegraph and of the telautograph, was working at the telephone at the same time as Bell. Gray undoubtedly experimented with a continuous circuit, with undulatory currents, and even with a battery transmitter.

Gray ran a very close race with Bell for the glorious invention of the telephone; indeed a preliminary patent application, or *caveat*, was lodged by each on the same day. But Bell secured priority for his invention and is universally recognised as the real inventor of the telephone. The insight which Gray had into the problem is shown by one of his patent drawings, in which we have a complete telephone circuit, with battery transmitter and magnet receiver. The variable resistance of the transmitter was a platinum wire dipping into a liquid. The variation of resistance due to the up and down movement of the platinum wire as it was vibrated by the diaphragm would be extremely small; still, the principle of the modern transmitter—an unbroken contact—was there.

We have skimmed rapidly over the underlying principles and we now come to the era of practical telephony—which began in 1877. The first complete telephone circuits used magnet telephones as both transmitters and receivers. The magnet telephone as a transmitter is practically a small dynamo, the prime mover being the human voice—a comparatively feeble source of energy. Although it is surprising how far and how well one can talk with a well-constructed magnet telephone and over a good line, still it was clear in the early days of telephony—when neither the apparatus nor the lines were very efficient—that to give the telephone sufficient range to make it of commercial value, a more powerful form of transmitter was required. Some workers endeavoured to make the magnet telephone more powerful; others turned their attention to the production of a battery transmitter. This was first produced by Edison. Edison utilised the principle, previously announced by Du Moncel, that the resistance at a contact between two conducting substances varied with variation in pressure. Both Count du Moncel and a French

engineer named Clarac had pointed out that carbon exhibited in a marked degree the property of diminishing its resistance with increase of pressure, and Edison relied rather upon this than upon actual variation of resistance at the point of contact.

FIG. 5.



EDISON CARBON TRANSMITTER.

In the early commercial form of the Edison transmitter the variable resistance was a button of compressed lamp black held between two plates, an ivory button conveying the vibrations of the diaphragm to the front plate.

At about the same time Berliner invented a battery transmitter, which also relied upon variation of resistance through variation of pressure at a contact. Berliner made his contacts of metal.

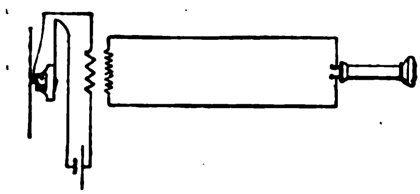
The introduction of the battery transmitter, which enabled external power to be applied to the telephone circuit, the flow of current being regulated by the changes in resistance of the transmitter due to the voice vibrations, was a notable advance in telephony. Mr. Edison at the same time made a contribution of great value to the telephone circuit by combining the transmitter with the induction coil. In the telephone circuit the induction coil becomes a sort of step-up transformer, sending out to line currents at comparatively high pressure, while the local or primary circuit is kept of low resistance, thus giving the variations in resistance of the transmitter their maximum range. This was a most valuable improvement, and the induction coil has since formed an essential part of the telephone transmitter.

In 1878, Professor Hughes explained the real principle of the telephone transmitter. By his famous microphone, by the beautiful experiments he conducted with it, and by the lucid explanation he gave of the phenomena observed, he threw a flood of light on the whole subject. He made clear that, for the maximum effect in change of resistance with change of pressure, the essential point was a loose contact.

Edison had worked with exactly opposite means, a compressed button held closely between two plates. Although there was a controversy at the time as to the invention of the carbon transmitter, it has long ago been recognised that Hughes was the first to demonstrate the correct principles on which telephone transmitters should be built, and since 1878 all transmitters have been built around the loose contact.

We now have the complete telephone circuit invented; the battery transmitter with induction coil, the magnet telephone taking its place as receiver.

FIG. 6.



COMPLETE TELEPHONE CIRCUIT; BATTERY TRANSMITTER, INDUCTION COIL AND RECEIVER.

It is worthy of note that within a year of the production of the first speaking telephone, which spoke at first in rather feeble and hesitating tones, the art of telephony had reached this advanced stage, in which we have all the essential features of the modern telephone circuit.

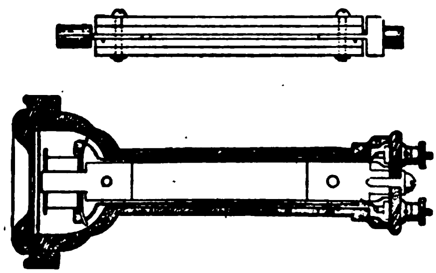
We may now consider the evolution of the magnet telephone as a receiver, which has been its function since 1878.

After passing through a few stages of somewhat crude mechanical design and arrangement (examples of early wood-case receivers were exhibited on the lecture table) the receiver took the form shown in Fig. 7.

The essential features are the laminated magnet, giving superior strength and permanence of magnetism as compared with a solid magnet, the soft iron pole-piece, the ebonite case, the small air chamber and the

shallow ear-piece. This is a receiver of about 1880, and it shows careful study of both the electro-magnetic and acoustic requirements of the receiver. The function of the currents circulating in the coil is to produce changes in the magnetic field in which the diaphragm is placed. Soft iron is more responsive to changes in magnetisation than steel, so the soft iron core quickly found its way to the top of the telephone magnet and has remained there ever since. Only for a year or two were receivers made with the coil mounted directly on the magnet. Acoustically, also, this receiver shows considerable advance on its immediate predecessor. We know that a resonating chamber—any column of air, in fact—has more or less effect on the quality of sounds, reinforcing some notes or vibrations to

Fig. 7.



Single Pole Receiver.

the detriment of others. This is familiar in the difference in the sound of voices in an empty room and in one that is furnished, or in the different sound given to a voice by speaking near or over a hollow vessel. The early wood-case receivers had large air chambers and deep ear-pieces, thus furnishing resonators which considerably distorted the sounds received. This trouble was cured by using the extremely small air-chamber and shallow ear-piece shown in Fig. 7, with a marked improvement in the quality of speech received.

In the early days many attempts were made to improve the magnet telephone by strengthening the magnetic field, by using two diaphragms, by employing clusters of magnets, by connecting magnetically the diaphragm with the magnet and by various combinations of the simple parts of which the instrument consists.

The late George M. Phelps, who worked assiduously in the commercial development of the telephone in its early days produced many types of instrument having combinations of several magnets.

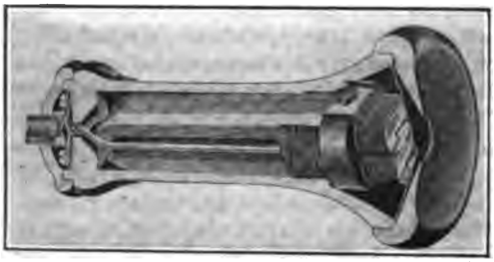
European investigators appear to have endeavoured to improve the magnetic circuit of the telephone. Among the many scores of receivers made in all shapes and forms in the early days of telephony, practically none has survived. That of Mr. Ader was the most interesting and the most practical. This was a double-pole receiver with a ring of soft iron placed in the ear-piece above the diaphragm. This iron ring Mr. Ader called a "super-exciter" and it is clear that the diaphragm is thus placed in a stronger magnetic field.

The evolution of the receiver has proceeded along the systematic lines of improvement in magnetic, mechanical, and acoustic details. The single-pole was some ten years ago replaced by the double-pole magnet, which was of superior power and sensitiveness, and at the same time resulted in a smaller and handier instrument. The diaphragm has practically not changed at all. It is of soft iron, a little over two inches in diameter and ·01 inch thick, either japanned or tinned to prevent rust. Many experiments have been made with diaphragms of varying thicknesses. It has been found that with thick diaphragms some of the higher overtones are lost, and the talking becomes thick and hoarse. With thin diaphragms the talking is sharp and clear, becoming shrill as the diaphragm diminishes in thickness. A very thin diaphragm tends to become pulled down on the pole piece, and general experience has settled on a thickness of ·01 inch. The diaphragm is placed as near to the pole pieces as it can be placed without risk of it being pulled into contact with the pole-pieces, the air-gap is usually 1-32nd of an inch, and the space between the diaphragm and the ear-piece the same. The ear-piece has become shallower, and the orifice smaller. The sensitiveness of the receiver depends upon the magnetic circuit being in a state of unstable magnetic equilibrium, so to speak. The permeability of the diaphragm must be high, and the field in which it is placed be concentrated, so that changes in the distribution of the lines of force caused by the currents circulating in the coil shall have the maximum effect. Great study is now made of the magnetic properties of the irons and steels used in telephone receivers, as the constant increase in the range of talking required constantly increases the demand on the power and sensitiveness of the receiver.

In mechanical design the telephone receiver

has been greatly improved. In the early single-pole receivers the magnet was attached to the rear end of the case. Unequal expansion often made the receiver useless by taking the diaphragm too near the magnet or too far away from it. It is now the practice to attach the magnet to the case at the shoulder. In the type shown in Fig. 8, a brass block is screwed

FIG. 8.



DOUBLE POLE RECEIVER.

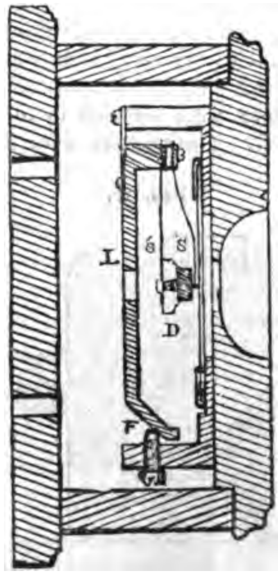
into the case. The cord is now frequently carried within the case instead of being attached to exposed terminals. Sometimes a metal case is used with ebonite covering. The telephone receiver has to stand much hard usage, and it must be proof against it.

EVOLUTION ON THE TRANSMITTER.

The earliest form of commercial transmitter was the well-known Blake instrument, Fig. 9, which was at one time extensively in use in England and America. Blake utilised the loose contact of Hughes and the carbon button of Edison, giving the rear electrode inertia by mounting it on a metal backing. The two electrodes, the front one a platinum point, were mounted on springs, so that they might follow all the motions of the diaphragm. An ingenious adjusting device, consisting of an angular iron bracket, to which the springs were attached, held under tension by an adjusting screw, was provided to maintain the two electrodes in constant contact. The Blake transmitter (Fig. 9), with one cell of Leclanché battery, and when everything was in proper condition, gave very clear talking over lines of moderate length; but it would not stand a high battery power, and it required frequent attention and adjustment. The adjustment was rather a delicate matter; frequently a a quarter-turn of the screw made all the difference between good talking and bad.

In Europe, after Professor Hughes published his famous paper on the microphone, many commercial transmitters were designed which were simply variations of Hughes's carbon pencil microphone. A large family of transmitters sprang up, in which carbon pencils were arranged in every conceivable manner, in single and double rows, in stars, in wheels,

FIG. 9.



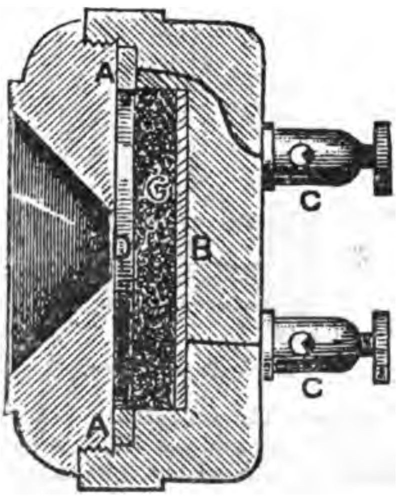
BLAKE TRANSMITTER.

in hexagons. These assemblies of blocks and pencils were generally attached to wooden diaphragms. The quality of talking from a microphone transmitter is very variable, as the instrument is very sensitive to jarring, and with strong battery power hissing and frying frequently occur, due to minute arcs at the contacts. Except in one or two countries the microphone transmitter has dropped out of use.

The Hunnings transmitter, of which Fig. 10 shows an early form, is the father of all modern transmitters. The granular carbon transmitters were invented by the Rev. Henry Hunnings, who seems to have made a meteoric flight into telephony. Even in its earliest and simplest form the granular carbon transmitter was a far more sensitive and powerful instrument than either the Blake or the carbon pencil family. It was free from the ordinary defects of both classes, the breaking, hissing, and frying, and the barrelly, hollow talking, but, unfortunately, it developed a serious defect of its own—a defect which took a long time to

overcome. This trouble has been called "packing," and for years "packing" was one of the greatest bugbears of the telephone engineer. The granular carbon transmitter came rapidly into use, as it gave clearer and louder talking than previous forms, and could be used with a higher battery power. The demand for long distance taking was constantly increasing, and a more powerful transmitter was a necessity. It was found, however, that the granular transmitter often became obstinately silent. This was attributed to the carbon granules becoming tightly packed together, so that they no longer vibrated freely. Many devices were resorted to to overcome this difficulty. Transmitters were made with

FIG. 10.



HUNNINGS TRANSMITTER.

the electrodes of irregular shape, so as to break up the granules; in some instruments the transmitter case was mounted on a pivot, so that it could be twisted round to shake up the granules when the talking became weak.

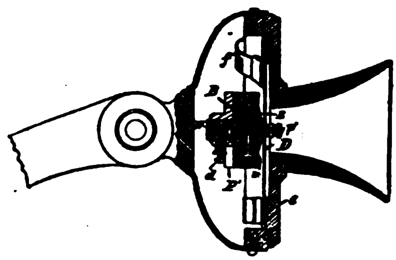
A type of granular transmitter in which special precautions were taken to prevent packing, was at one time extensively used in America, called the "long distance." It had a platinum diaphragm, set horizontally, on which the carbon granules rested, and the upper electrode was in the shape of a pulley, grooved and pierced so as to allow the granules to be well distributed. This was a powerful transmitter, and could be used with three cells of Fuller battery, giving about six volts. It gave good talking over very long lines when in good condition, but it suffered from the packing evil, and at times would become as silent as a block of solid metal.

Packing is due not merely to the carbon granules becoming settled down, but to the expansion due to heating causing the granules to swell together into a mass. In a granular transmitter the resistance is often very low, less than an ohm, and sufficient current passes to generate considerable heat. The cause of the packing trouble was therefore inherent to the instrument if a powerful transmitter was required.

A detailed investigation of this and other properties of granular transmitters, carried out at laboratories of the American Bell Telephone Company and at the Massachusetts Institute of Technology, resulted in showing that the packing trouble could be cured by giving the granules space to expand, and that the greatest effect in change of resistance from change of pressure was obtained by mounting the rear electrode rigidly.

The "solid back" transmitter (Fig. 11) was

FIG. 11.



SOLID BACK TRANSMITTER.

the result of these researches, and was designed by Mr. Anthony White about thirteen years ago. This is the most powerful telephone transmitter in use, and does daily commercial talking over distances ranging from a few yards up to 2,000 miles. The two electrodes are small discs of carbon, slightly smaller than the containing chamber. The rear electrode is attached to a brass block rigidly held by a substantial brass bridge. The front electrode is connected by a pin to the diaphragm, a washer over the same pin holding a mica disc which closes the granule containing chamber. The front electrode has a piston-like action in the chamber, the mica disc having sufficient elasticity to allow the electrode to vibrate freely. The mica is proof against the heat generated in the transmitter, which the felt ring used to give elasticity in earlier types of small granular transmitter was not. The carbon

granules only partly fill the space between the two electrodes, and thus have free space in which to expand when they become heated.

This transmitter has been successful in overcoming the packing difficulty, and when once properly set up it rarely develops faults of any sort. Its general design has been extensively copied, and, like the Hughes microphone, it is the father of a whole family of instruments.

In another family of granular transmitters, a containing chamber with elastic sides is employed. This is generally secured by the use of a ring of felt, which has caused this type of instrument to be irreverently dubbed in America the "cornplaster" transmitter. Sometimes the felt separator is simply a ring, sometimes it is a disc pierced with several holes to split up the granules more.

Great attention must be paid to the workmanship, quality of materials, and details of assembly in telephone transmitters. The preparation of the carbon granules has become quite a specialty and much care is expended on getting carbon of a high degree of hardness and fineness, practically small black diamonds. The acoustic properties of transmitters are also of importance. A small degree of distortion necessarily takes place in the transmitter, as there is a conversion of energy from one form to another. Any unnecessary addition to this distortion must be guarded against. The fundamental note of the diaphragm must be damped out, and anything in the shape of a resonating chamber which would tend to reinforce some vibrations over others must be avoided.

At various times there have been many what might be called "freak" transmitters invented, instruments with multiple contacts and multiple diaphragms. These were very frequent in the early days, when it was not realised that the line was the principal problem, not the instruments. Broadly speaking none of these devices has lived, but the double diaphragm idea has lately been revived in a commercial transmitter. This instrument has two granular chambers back to back, the two diaphragms being placed in a chamber parallel with the mouthpiece.

Signalling Appliances.

To use the telephone it is necessary to have means of signalling and of being signalled. When the telephone appeared the ordinary trembling electric bell was already in general use and it was at once pressed into the service of the telephone. It quickly became evident that the batteries required for signalling over lines of any length were expensive, unreliable, and troublesome, and the magneto call and polarised bell, not unknown but not then much used, were soon substituted for batteries and trembling bells.

The magneto generator is such a well-known appliance that it needs no description. It is simply a small hand-driven alternating current dynamo. The armature of the bell is polarised by a permanent magnet, giving it a normal bias, and so making it responsive to normal currents.

The magneto generator proved such a simple and adequate means for signalling on telephone lines, that it soon became almost universally an indispensable part of the telephone set. In the early days it was inserted in series in the line and an automatic shunt had to be devised to short-circuit the armature coil when the generator was not in use. There are various forms of automatic shunt. In one most generally used the spindle of the armature coil normally short circuits the coil by pressing against a contact, from which it is drawn when the handle is turned by the action of a pin which rides up from a notch in the hub of the driving wheel.

The telephone station must have two different positions: one for sending and receiving signals and one for sending and receiving speech. At first a hand switch was used for changing the circuit from one position to another. It was soon seen that the weight of the receiver afforded means for effecting this change automatically, and the automatic switch-hook was invented. This device plays an important function in the telephone set, and its details have received much study. In the early days the arm of the hook formed part of the circuit, and it worked between leaf contacts. There was more or less uncertainty about this, and in modern practice the contacts are separated from the hook, and are simply controlled by it.

Circuits of Telephone Sets.

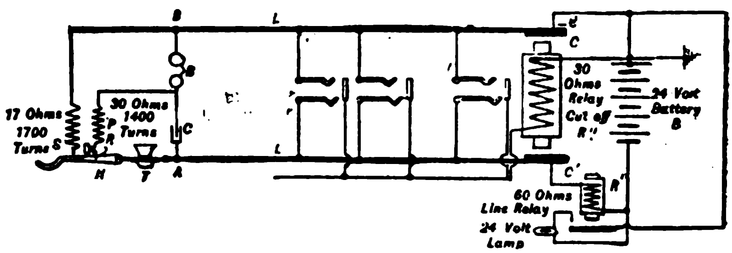
We have now surveyed the essential parts of the complete telephone set. These parts may be joined up in a variety of different ways. In the early days, when single lines with earth return were generally used, everything was joined in series.

Such a circuit has various disadvantages. The resistance of the bell coils, with that of the generator armature if the shunt contact failed, was in the talking circuit; on long lines with several stations both talking and

signalling became ineffective. Mr J. J. Carty then invented the bridging bell, which completely cured this trouble and gave a much superior circuit. In the bridging bell both the bell and the generator are in bridge across the line. The bell coils, having long cores and being wound to a high resistance, offer high impedance to telephonic currents and do not shunt them. With this arrangement practically any number of telephones may be worked on one line with good results.

Finally, we have the common battery circuit, the standard circuit of to-day, in which the arrangement of the sub-station is much simplified. The transmitter battery has disappeared, as current is supplied from the central office; the generator has disappeared, as the same central battery operates the signals at the central office. There are left only the transmitter, induction coil, receiver, and bell, and the automatic switch to change the circuit from the signalling to the talking position. There is one additional part, that inconspicuous and most serviceable electrical device—the condenser. The condenser serves to maintain the line normally "open" to direct current, but allows the polarised bell to be rung by alternating current. As may readily be seen, the various elements of a common battery sub-station circuit may be arranged in a variety of ways, and, owing to the reactions between the coil, condenser, transmitter, and receiver, different ways will give different talking results. Innumerable different arrangements of the circuits have been tried; the circuit shown in Fig. 12 is that which on the whole is found to give the best results.

FIG. 12.



CIRCUIT OF COMMON BATTERY, SUB-STATION SET.

COMPLETE TELEPHONE SETS.

Having traced the manner in which the various parts of the telephone sub-station have been evolved, I now invite you to go back to 1877 and make a rapid survey of the evolution of the complete commercial telephone set.

Not very long after the speaking telephone was shown to be a practical success commercial instruments were put on the market. The first of these was a hand magneto telephone. This was in use in 1877. It was not beautiful but appears to have been built for strength and to have been well finished. A short time later a complete telephone set was on the market, and this is specially interesting as it contained all the elements of the modern set; generator, bell, and automatic switch.

The wall set of the same period was the prototype of the wall set which has become so familiar. Here we have a separate transmitter, receiver, generator, and bell. The circuit was changed, however, from the signalling to the speaking position by a hand-switch.*

In connection with these early commercial instruments, it will no doubt be interesting to many if I quote a few lines from the first circular issued in connection with the telephone industry. It is dated Boston, May, 1877, and reads as follows:—

"The proprietors of the telephone, the invention of Alexander Graham Bell, for which patents have been issued by the United States and Great Britain, are now prepared to furnish telephones for the transmission of articulate speech through instruments not more than twenty miles apart. Conversation can be easily carried on after slight practice, and with the occasional repetition of a word or a sentence. On first listening to the telephone, though the sound is perfectly audible, the articulation seems to be indistinct; but after a few trials the ear becomes accustomed to the peculiar sound, and finds little difficulty in understanding the words.

"The telephone should be set in a quiet place,

* Illustrations of these early commercial telephones were shown at the lecture.

where there is no noise which would interrupt ordinary conversation.

"The advantages of the telephone over the telegraph for local business are:—

"1st. That no skilled operator is required, but direct communication may be had by speech without the intervention of a third person.

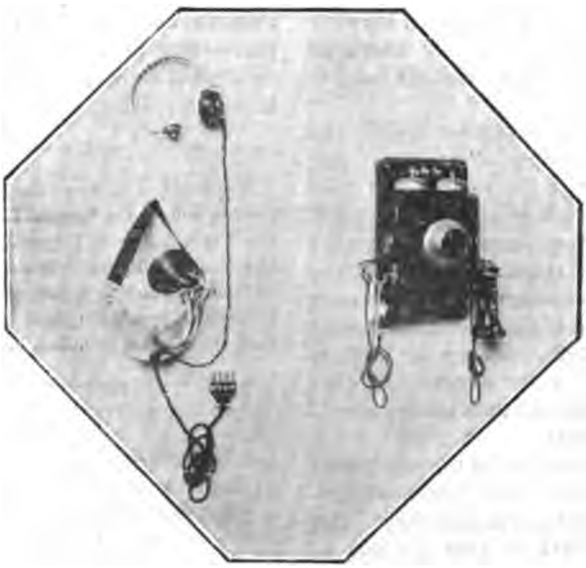
"2nd. That the communication is much more rapid, the average number of words transmitted a minute by Morse Sounder being from fifteen to twenty, by telephone from one to two hundred."

"3rd. That no expense is reported either for its operation, maintenance, or repair. It needs no battery, and has no complicated machinery. It is unsurpassed for economy and simplicity."

of the transmitter, and the absence of a rigid support are not good for long distance talking, and the instrument, as a whole, is more subject to risk of damage than when only the receiver is movable.

In the common battery set, the standard instrument of to-day, of which a wall pattern set is shown in Fig. 13, it is noticeable that the sub-station has become much more compact. The elimination of the generator and battery has eliminated much bulky cabinet work. The switch-hook offers a notable detail. It was found that people who did not "keep their eye on the ball," to use a golfing phrase,

FIG. 13.



OPERATOR'S TELEPHONE SET AND WALL PATTERN COMMON BATTERY SET.

The microtelephone or hand set, which was first used in America about 25 years ago as a switchboard instrument, has become very popular in Europe. It has its advantages and disadvantages. With a wall set it makes the position of the telephone independent of the height of the user. With a desk set it is a comfort no doubt at times to be able to sit back with the telephone instead of leaning forward to it; but the hand set involves a long cord, and the long cord hss a terrible habit of coiling itself up under a pile of papers and books, sometimes with disastrous results. Electrically, the hand set is not so good as the fixed transmitter. The long cord with its numerous conductors is a weak spot from a maintenance point of view; the shaking up frequently jabbed the receiver downward so that a point of the switch-hook dented or bent the diaphragm. This resulted in many damaged receivers, and much bad service. Even curving the ends of the prong does not cure the trouble, as many people prefer to do things upside down, and jabbed the receiver diaphragm up. So it became necessary to shape the ends of the hook in a ring of sufficient radius that it was impossible to damage the diaphragm by means of the hook. People had to choose other means. This is just an illustration of the great attention which must be paid even to the smallest detail in telephone work, and of the necessity for the telephone engineer to guard against the damage which thoughtless and careless

members of the public so quickly deal out to whatever machinery is placed in their hands.

We have now traced fairly completely I hope, but necessarily in a very condensed manner, the evolution of the modern telephone set—the sub-station plant of the telephone system. There is one other complete telephone of interest—the operator's set. (Fig. 13). In the earliest switchboards, the operators, as I have just said, were provided with hand sets, and thus had only one hand free to work with. Within a year or two the head-band receiver was devised, and the transmitter was mounted separately, at first on a column or bracket, and later suspended by cords from the top of the switchboard. This arrangement, though it gave the operator both hands free, obstructed her view of the switchboard and relatively restricted her movements, since the transmitter hung in one position.

The breastplate transmitter gives the operator complete freedom of movement, and also makes the face of the switchboard clear of all obstruction, while it has an incidental advantage in giving each operator her individual set. The shield and case of the transmitter are of aluminium and are extremely light; the head-band of the receiver is pierced to reduce the weight. Many a load of jewellery carried for mere ornament is considerably more of a burden than the operator's receiver and transmitter.

The survey of the evolution of the sub-station shows that it has been greatly improved both in electrical and mechanical efficiency. The standard telephone set is now capable of talking nearly 2,000 miles, which is a vast increase of range. What such distances mean may be realised when it is considered that telephone conversation is now daily held between cities which are two days' journey apart by the fastest trains. Moreover, the same instrument is used for talking across the street as for talking over the longest distances. This is a variation of load which I think occurs in no other form of electrical apparatus, and it illustrates strikingly the flexibility of the telephone instrument.

The use which the telephone gets is severe. Much more severe nowadays than it was in the beginning. It must be remembered that almost every telephone, although we habitually speak of a telephone as representing a subscriber, is really used daily by a number of different people. The telephone is in the hands of the public without being owned by the user, and therefore, in the main, it is less carefully treated than it might be. It is also used a great deal more frequently than it formerly was. Many telephones are used both for internal communication and for the outside service, and it is not unusual for an instrument to be used from 50 to 100 times a day the year through. Notwithstanding these trying circumstances, the mechanical design has been so improved and the construction so much solidified and simplified that the telephone instrument rarely gets out of order. Many instruments remain in service year in and year out without giving serious trouble.

There are many special uses of the telephone and many different types of instruments have been designed for particular uses, on board ship, in military operations—where the telephone now plays an invaluable part—in the conduct of railway and tramway services, and in mining, diving, and other work.

Specimens of some of these special types of telephones, lent by the General Electric Company and by the Western Electric Company, together with some highly interesting instruments from the priceless collection of historical apparatus at the Post Office, lent by Mr. J. Gavey, Engineer-in-Chief to the General Post Office, were exhibited on the lecture table.

THE INDUSTRIES OF MOROCCO.

The best known, if not the most important industry of Morocco is the manufacture of carpets. The Rabat varieties are the most esteemed, and these somewhat resemble Smyrna carpets, but vary considerably in size. They are remarkable for their very brilliant colouring, red predominating. The number of these carpets sold annually exceeds 4,000. The process of manufacture, according to the "Annuaire du Maroc," is a careful and a very long one, the work being exclusively confined to women, who have acquired remarkable proficiency in it. Notwithstanding the reputation these carpets enjoy, very few of them are exported from Morocco, the natives—by whom they are greatly appreciated—preferring to keep them for their own use in the country itself. Of those which are found in Europe, the majority are manufactured at Casablanca or at Mequinez, and they are of a distinctly inferior quality. At Mequinez, the manufacture of carpets, which at one time was a well-developed industry, has lost much of its original importance. Another industry which affords employment to a considerable number of people, particularly at Salé and Ouezzan, consists of the manufacture of a kind of woollen tissue known by the name of "Hombel." At Salé, eighty native

houses are engaged in its production; At Ouezzan, about forty; and a few at Tetuan. The leathers manufactured at Tafilet, as well as those of Marrakech, Fez, and Tetuan, are well known, and enjoy a good reputation. They are remarkable for their supple qualities, which they owe to a prolonged maceration in certain vegetable substances the nature of which does not appear to be generally known. Their red dye is obtained from the nuts of a tree called "Takaout" which chiefly grows on the borders of Oued-Draa. Attempts have recently been made to acclimatise this tree in Algeria, but with what results is at present unknown. Many of these leathers are also dyed yellow, and these are used in the manufacture of the slippers which are so much in vogue in the Mussulman world. These slippers, manufactured in Morocco, are greatly used by the natives, and are exported in considerable quantities to Egypt, Algeria, and the Sudan. At one time silk tissues and embroideries, which are still products of Fez, were manufactured with silk coming from Djebel. The raw material now comes from France and Italy. The celebrated pottery, earthenware and mosaic industries, so much vaunted in the middle ages, appear no longer to exist, only a few enamels being still produced in Fez and Saffi. The milling industry in Morocco is carried on in a very crude and primitive manner, even in the preparation of olive oil the crushing of the fruit is effected by two mill stones. There are, however, indications of an attempt to erect properly constructed mills, principally at Tangiers, where the Sultan, twenty-five years ago, built a steam mill, which has since been abandoned. This is an industry in which Europeans, principally Frenchmen, engage very largely, and at the present time there are five mills worked by steam at Tangiers, one at Laraiche, one at Saffi, and one at Mogador, owned by French firms. A native industry, of which Europeans appear to be taking possession, is the manufacture of soft soap, of which the inhabitants of Morocco use considerable quantities. These soaps are manufactured very easily without any particular knowledge, scientific or otherwise, being required, and the products of the country alone are used in their composition. At Tangiers, and at Mogador, this industry is in the hands of French firms. Two manufactories of farinaceous substances, one in Tangiers and the other at Mazagan, both French, almost suffice for the requirements of the coast ports. The Sultan has recently admitted their products to the benefits of the coasting trade. The manufacture of cigarettes has during the last few years greatly increased. Independently of the establishments which have for some considerable time past been in existence at Tangiers, a factory has recently been established at Casablanca, and its working has been attended with some success. Mineral waters are supplied by Tangiers, Tetuan, Casablanca, and Mogador, while a distillery is working very satisfactorily at Laraiche. The distillation of alcohol is carried on very extensively in Morocco, where it is the exception not to find a still in every Jewish shop. It is stated to be a subject for regret that a spinning wheel has not yet been established at Laraiche, as the probabilities are that it would be fully engaged with the wool which is exported, as well as that which is worked up at present by the natives by a costly and tiresome process. In the manufacture of matches, one establishment is engaged at Tangiers, and at Fez and Mequinez an attempt was made fifteen years ago to produce sugar, but was not successful. The production of bricks is another local industry, and this is carried on at Tangiers. Almost the whole of the industries of Morocco (94 per cent.) are in the hands of the French.

THE GREAT ZIMBABWE.

The Times correspondent reports a lecture on the Rhodesian ruins delivered by Mr. MacIvor before the British Association at Bulawayo, which tends to upset previous theories as to the origin of these remarkable structures, and to rob them of the immemorial antiquity claimed on their behalf by previous explorers such as Mr. Bent, and Mr. Hall, whose paper on the subject read last April, will be in the recollection of Members. The lecturer went to Rhodesia last April, under the auspices of the Rhodes trustees and the British Association, and made a detailed study of Zimbabwe and other ruins. After careful investigation he decided that none of the ruins in Southern Rhodesia is older than the fifteenth or sixteenth century, and that they are the handiwork of African natives of the negro or negroid race under the dynasty known by the collective name of Monomotapa.

The buildings are essentially of a native kind or type common to-day; nearly all retain some original wooden stakes embedded in the walls; there is no trace of inscriptions on any of the ruins; stone and iron implements were found together; neither the buildings nor the other articles found, show traces of early Oriental or European influence; finally, the discovery of pieces of blue and white Nankin china and other articles of mediæval manufacture in the lowest parts of the foundations proves that such commodities were the object of barter before the buildings were erected. In the case of Zimbabwe, he controverts the statements that the foundations show a series of layers of different periods; but he admits that in one layer of sand charred wood found some way below the previous excavations may indicate an earlier period, though this is unlikely. Mr. MacIver maintains that the ruins were originally fortified places, usually enclosing a kopje built in the form of a rough ellipse following mainly the contour of the surrounding country. The so-called slave pits, described as pit dwellings, were originally citadels of their strong places round which concentric circles of walls were built. Zimbabwe, as the residence of the Monomotapa, was more carefully and elaborately built

than the others, but its plan is essentially the same. The elliptical temple would therefore be a trial fortress. The soapstone birds discovered by Mr. Bent represent totems. A race still exists—Kaffir tribe—with an eagle totem.

On the publication of the summary of Mr. MacIvor, Dr. Keane sent a letter to *The Times*, controverting his arguments, and strongly maintaining the views of the original explorers as to the extreme antiquity of the ruins.

HAT-MAKING SCHOOL IN PANAMA.

A central school of hat-making, and for the cultivation and improvement of toquilla straw, has been established in the district of Arraijan. The school is provided for by Government funds, and will be under the authority of the Minister of Public Works. Fourteen scholarships have been established, two to be filled from each of the seven provinces of the Republic of Panama. Besides the holders of these scholarships, pupils who so desire will be received in the school as externs, to the number of thirty-six. Applicants for scholarship must be not less than 15 years of age, of good conduct and health, willing and desirous of learning hat-making, have good eyesight, be of cheerful disposition, and, if possible, have had some previous knowledge of making hats from toquilla straw. Each pupil will be expected, as a return for his instruction, to undertake to teach the same industry in whatever place may be designated by the Government. In case of refusal to do so, his father or guardian will be called upon to repay all the expenses incurred by his education. The school was opened—according to the United States representative at Panama—on June 15 last, and the governors of all the provinces have been notified to inform the public and receive applications for admission. The three officials of the school have been selected, and proceeded in May last to Ecuador, where most of the "Panama" hats are made, there to engage the services of workmen.

CORRESPONDENCE.

MEXICO.

I have just returned from Mexico, and have been interested in reading the articles which appeared in the *Journal* in May and July last. From personal observations I can confirm, with regret, what is stated with regard to British trade.

English goods are appreciated and English people liked, but for some reason which I cannot fathom our manufacturers, with few exceptions, seem to take no steps to increase their trade with Mexico, although I am confident that the present turnover might easily be increased by 25 per cent. or more.

On this side scarcely any endeavour is made to ascertain what goods are required, and if catalogues are sent out and enquiries result, there are no opportunities of seeing specimens of the goods in Mexico, so that in sending orders it is necessary to work from a catalogue description—mostly printed in English—and trust to the article when it arrives being the same as the catalogue would lead one to suppose.

I regret to find that our Government, instead of increasing facilities, are about to take a retrograde step, as it is proposed that instead of having a Consul in Mexico city there should only be a Vice-Consul, notwithstanding other nations are represented by Consuls-General. Considering that Mexico city has 400,000 inhabitants, is well equipped with all modern appliances, and, above all, is the great distributing centre for the Republic, I am at a loss to understand the proposed change. A petition for presentation to the Foreign Office has been drawn up and signed by British business men in Mexico, and it is to be hoped that additional pressure may be brought to bear here to prevent the proposition being carried into effect.

In the article which appeared in the *Journal* of July 28th I notice a comparison between the international shipping 1885–6 and 1902–3, but should like to point out that the figures given do not answer any useful purpose in consequence of certain changes in the compilation of these statistics during the last few years, and further, on comparing the figures for 1902–3 with those which appeared in the Government returns, I find that they only represent one section of the international trade, viz., "the direct," the figures for vessels calling at various Mexican ports not being included. Further, the figures quoted are compiled according to the flags carried by the various vessels, but do not in any way afford a clue as to the countries from which they came. I append a statement "A," showing how this materially affects the data, and "B," the tonnage omitted by not including vessels calling at various ports.

To the Fiscal statistics for the first six months of the year 1898-9 is appended a note with reference to navigation, stating that important modifications had been made in regard to this branch of statistics, and it would therefore appear that as the bases differ it is not practicable to compare 1885-6 with 1892-3. It may, however, be of some interest to show how the totals inwards for 1898-9 compare with 1902-3 "C," and I also append "D," a comparison by countries, showing the figures for England, France, Germany, and the United States.

Of course a considerable quantity of high-class material enters Mexico by rail, and as mere tonnage gives very little indication of value, statement "E" will better show the progress made by each of these countries.

S. CHAPMAN.

225-8, Gresham-house, Old Broad-street,
London, E.C.

A.—Vessels Entering a Mexican Port Direct (1902-1903).

Classified according to Flags.

	Loaded.	In Ballast.	Total.	Register Tonnage. Loaded.	Register Tonnage. In Ballast.	Register Tonnage. Total.	Tons of Merchandise.
British—Steam	285	20	305	777,613	30,690	808,303	600,357
,, Sailing	131	57	188	29,160	2,811	31,971	35,608
United States—Steam	197	41	238	605,341	89,231	694,572	102,721
,, Sailing	171	39	210	54,278	2,134	56,412	74,507
Norwegian—Steam	117	84	201	184,472	109,456	293,928	140,313
,, Sailing	15	40	55	8,193	18,008	26,201	8,479
Spanish—Steam	64	—	64	248,231	—	248,231	128,637
,, Sailing	4	1	5	968	9	977	460
German—Steam	65	20	85	224,420	48,188	272,608	80,930
,, Sailing	20	3	23	31,876	1,066	32,942	38,844
French—Steam	13	1	14	74,877	5,357	80,234	6,383
,, Sailing	—	—	—	—	—	—	—
	1,082	306	1,388	2,239,429	306,950	2,546,379	1,217,239

A.—Vessels Entering a Mexican Port Direct (1902-1903).

Classified according to Countries from which they have come.

	Loaded.	In Ballast.	Total.	Register Tonnage. Loaded.	Register Tonnage. In Ballast.	Register Tonnage. Total.	Tons of Merchandise.
British—Steam	120	5	125	414,074	7,216	421,290	254,635
,, Sailing	89	31	120	36,090	11,755	47,845	52,300
United States—Steam	470	49	519	1,101,861	67,031	1,168,892	598,460
,, Sailing	172	43	215	45,861	3,299	49,160	62,115
Norwegian—Steam	—	—	—	—	—	—	—
,, Sailing	—	4	4	—	1,991	1,991	—
Spanish—Steam	13	—	13	58,033	—	58,033	5,252
,, Sailing	—	2	2	—	968	968	—
German—Steam	52	2	54	184,284	5,593	189,877	67,177
,, Sailing	28	—	28	39,956	—	39,956	46,237
French—Steam	16	—	16	83,442	—	83,442	7,769
,, Sailing	10	4	14	2,967	1,380	4,347	3,555
	970	140	1,110	1,966,568	99,233	2,065,801	1,097,500

B.—Tons of Merchandise Conveyed to Mexican Ports (1902-1903).

From.	Direct.	Calling at Various Ports.	Total.
England	306,935	71,857	378,792
United States	660,575	91,488	752,063
Norway	—	—	—
Spain	5,252	2,910	8,162
Germany	113,414	34,764	148,178
France	11,324	694	12,018
Total	1,097,500	201,713	1,299,213

C.—Statement showing Comparison between Ships arriving at Mexican Ports from all Countries together with Tonnage of Goods Landed from same.

Fiscal Years 1898-9 *and* 1902-3.

	Direct.	Calling at Mexican Ports.	Total.
Number of ships, 1898-9			
Loaded	938	688	1,626
In ballast	564	181	745
Register tonnage—			
Loaded	1,505,774	1,450,121	2,955,895
In ballast	332,424	338,180	670,604
Number of tons of cargo	690,927	217,647	908,574
Number of ships, 1902-3			
Loaded	1,153	693	1,846
In ballast	346	104	450
Register tonnage—			
Loaded	2,372,785	1,815,345	4,188,130
In ballast	344,009	206,835	550,844
Number of tons of cargo	1,332,428	225,286	1,557,714

D.—Statement showing Comparison between Ships arriving at Mexican Ports from the undermentioned Countries, together with Tonnage of Goods Landed from same.

Fiscal Years 1898-9 *and* 1902-3.

	United States.			England.			France.			Germany.		
	Direct.	Calling at Mexican ports.	Total.	Direct.	Calling at Mexican ports.	Total.	Direct.	Calling at Mexican ports.	Total.	Direct.	Calling at Mexican ports.	Total.
Number of ships—												
Loaded 1898-9	523	394	917	132	82	214	37	4	41	67	55	122
In ballast ,,	119	117	236	99	13	112	3	2	5	2	1	3
Loaded 1902-3	642	377	1,019	209	96	305	26	3	29	80	64	[illegible]
In ballast ,,	92	56	148	36	18	54	4	4	8	2	7	[illegible]
Register tonnage—												
Loaded 1898-9	710,003	760,111	1,480,014	284,400	227,404	511,804	96,569	2,048	98,617	136,798	123,010	[illegible]
In ballast ,,	137,976	241,859	379,835	10,711	14,564	25,275	1,382	585	1,967	1,162	581	[illegible]
Loaded 1902-3	1,147,722	904,962	2,052,684	450,164	322,454	772,618	86,409	10,267	96,676	224,240	201,466	[illegible]
In ballast ,,	70,330	120,044	190,374	18,971	24,324	43,2[illegible]5	1,380	1,394	2,774	5,593	21,667	[illegible]
No. of tons of cargo—												
1898-9	418,051	117,420	535,471	157,340	43,691	201,031	11,474	888	12,362	61,043	24,907	[illegible]
1902-3	660,575	91,488	752,063	306,935	71,857	378,702	11,324	694	12,018	113,414	34,764	[illegible]

E. Total Value of Imports to Mexico from the Undermentioned.

By sea and by land.

	1898-9.	1902-3.	Increase.	Per cent.
	* dols.	dols.	dols.	
United States	24,164,687	40,795,956	16,631,269	68·8
England	9,211,221	10,331,116	1,119,895	12·2
France	5,917,167	6,537,289	620,122	10·5
Germany	5,677,925	9,569,039	3,891,114	68·5
All countries	50,869,194	75,904,808	25,035,614	49·2

* Values expressed in gold:—United States = par; £1 sterling = 5 dols.; 1 franc = 0·20 dols.; 1 mark = 0·25 dols.

HOME INDUSTRIES.

Apples for Vintage.—It was stated in the *Journal* of September 1st that the cost of the first year's operations on an acre of hops properly dealt with was estimated by authority at £44 13s. The cost of planting an acre of apple trees for vintage purposes is much less but still considerable. In his evidence before the Departmental Committee on Fruit Culture Mr. J. Riley, who is a leading fruit grower at Ledbury, Hereford, gave his own experience. Of course the cost varies with different counties. Mr. Riley referred to Hereford alone, which has a larger average of orchards than any other county in the kingdom—27,221 acres against 27,184 of Devonshire—taking the average of the years 1901-03. The cost of each tree, 2s.; digging out holes and planting, 2d.; cutting and putting on wire, 1d.; seven feet wire netting three feet wide, 6½d.; twelve yards of barbed wire, 5½d.; a wooden staple of a fair size, 2d. or an iron staple 9d. That makes a total cost of 4s. 2d. a tree. In Herefordshire 40 to 50 trees go to the acre, which would make the cost of planting about £10. In Kent as many as 300 have been planted to the acre. Of 27,221 acres of orchards in Hereford about 75 per cent. is vintage fruit, and the value of the fruit alone in an average year may be put at £200,000, the remaining 7,000 acres being pot fruit.

On the whole it would seem that cider fruit pays as well as apples grown for dessert or culinary purposes. It suits many people to grow cider fruit. They can make a success of it when they would not be successful with cooking fruit or dessert fruit. Many varieties of cider fruit are not so susceptible to insect pests. What are called the bitter-sweet apples have a very leathery skin, and they are not so likely to be attacked by the codlin moth, for instance. The blossom, too, is less sensitive. For these reasons the cider fruit tree can be relied upon to bear more regularly than some of the eating apples. The cider fruit is shaken down, and not being hand picked takes less labour. Nor has it to be marketed at the exact moment. Many of the vintage apples keep well for several months if they are put down and are perfectly sound.

The Age of Orchards.—Unfortunately, a great many of the existing orchards are very old. The West Country orchard began to be planted at the end of the seventeenth century, flourished through the whole of the eighteenth century, and up to 1830, when the trees began to go rapidly down. A French work, published as far back as 1681, speaks of England as the country in Europe where the best cider is made, the cider of Normandy coming next. The life of a standard apple tree has been likened somewhat loosely to that of a man. Up to ten years it does not bear very heavily, after that its production augments rapidly to thirty-five or forty years. From then up to fifty or sixty it is at its maximum state of fertility, after that it declines, and at the age of eighty it is generally unprofitable to keep longer. But many of the apple trees still bearing are of almost fabulous age. Within the last ten years there has been a revival of interest in orchards, and it may be hoped that re-planting will now go on more rapidly.

The Period of Growth.—The chief impediment in the way—apart from the question of compensation—is the length of time intervening between planting and profitable return. It is a great drawback to cocoa planting to have to wait seven years for full bearing of the trees, but there is nothing like profitable return from a vintage orchard for ten years. But afterwards it is a gold mine. There is nothing like it in home agriculture for great profit. And it has to be remembered that, although the orchard does not give any adequate return until after it has been planted ten years, the grazing of orchards is as valuable as a piece of land that does not bear apples. In some cases it is more valuable on account of the shelter. It is very valuable in the spring, when farmers rely on it for their grass for their lambs and ewes, so that the apple crop is obtained at no sacrifice of income on the part of the landlord except the outlay of capital necessary to plant the trees. But that, as has been shown, is heavy.

The Question of Compensation.—The provisions of the Market Gardeners' Compensation Act (since incorporated in the Agricultural Holdings Act of 1900) allow a tenant of a holding, which it is agreed in writing shall be let or treated as a market garden, to plant fruit and erect the necessary buildings without having first to obtain the consent of his landlord, and at the end of his tenancy he is entitled to compensation, which often amounts to a very large sum an acre, and this acts as a deterrent, landlords refusing to let land for the purpose of the cultivation of fruit fearing the heavy compensation they may have to pay at the end of the tenancy. The difficulty has hitherto been avoided in some of the important fruit-growing districts either by the granting of leases sufficiently long to permit of the tenant recouping himself for the cost of his plantation (*e.g.* in Kent), or by the landlord selling his land in small holdings (*e.g.* in the Wisbech district), or by the outgoing tenant making arrangements with the incoming tenant (*e.g.* in the Evesham district). In fact the planting of fruit has continued to increase since the passing of the Act, but it is believed that it would increase more rapidly if landlord and tenant were in nearer agreement as to equitable procedure. Under present circumstances few landlords are willing, or, perhaps, are able to find the capital necessary to plant the orchards, and often tenants are very neglectful in looking after it. They only interest themselves in them when the fruit-bearing stage is reached.

Owners as Cultivators.—The Committee on the Fruit Industry, discussing this question, expressed the opinion that it would be far more satisfactory if the fruit growers were the owners of their plantations and market gardens. The fruit grower expends large sums of money on his holding in improvements which are permanent, or at least likely to last for a considerable time, and if he is successful he adds immensely to its value. In this respect, it is urged, his position is very different from that of the ordinary agricultural tenant in whose case permanent improvements are usually made by the landlord. Many of the witnesses before the Committee spoke of the advantages of "small holdings," and the great development of the Wisbech district was largely attributed to the fact that the growers had been able, in most cases, to buy their holdings. The desirability of ownership applies in special degree to the cultivation of small fruit, but orchards, too, would be better it is thought, if cultivator and owner were one.

Cider a National Drink.—There are many difficulties in the way of cider becoming a really national drink, as it is in the North of France. The farmer can always make a limited quantity of first-class cider, but a large number of farmers have not the technical knowledge, and they make cider anyhow. The juice is simply pressed from the fruit, and the fermentations entirely uncontrolled. Sometimes they turn out a good article, but it is a matter of chance. Then often the right kind of fruit is not planted. Speaking as to this, Mr. John H. Wootton, who is instructor in cider making to the County Councils of Hereford, Worcester, Dorset, Gloucester, Monmouth, and Salop, told the Committee that the stock in general use, as supplied by the nurserymen, is almost worthless to produce orchards of standard trees. The only stock that should be used, said Mr. Wootton, for standard trees in orchards is the crab stock, which you cannot purchase from any nurseryman in England, or from very few. All the old orchards, planted a century ago, were worked upon crab stock only. Now the common practice is, according to Mr. Wootton, to sow the pip of the apple, and it is really an apple stock, the most unsuitable stock, in his opinion, that could be used for any purpose. It is not a question with the nurseryman whether the trees will last five years or a hundred years. It is his business to produce them at as early a date as possible, and to be able to sell the trees that look the most suitable for the purpose.

Brewers and Cider.—Then cider making is a very intricate business which demands much attention and the farmer has many occupaticns and distractions. In the making of cider a similar process seems to be going on as is to be seen in breweries. Fifty years ago a great many public houses brewed their own beer, now they seldom or never do. In the same way the farmer, who used to make cider for sale is giving it up and the manufacture is going into the hands of the professional. It has been the same with wine making in France. Professional cider making has proved beneficial to the fruit grower because it has enabled his produce to be used to greater advantage and probably in greater quantities. Brewers, however, are not willing apparently to push the sale of cider. Mr. John Watkins, a fruit grower from Herefordshire, told the Committee that the tied-house system is very detrimental to the sale of cider, and he gave an instance. He was supplying, when they were free to take cider, fifteen houses which belonged to a firm of brewers who had about 250 houses. They came to Mr. Watkins and said, "You must quote us the very lowest lines you can for the supply of all our houses and we will tie our houses to your order, or we shall have our cider from someone else." Mr. Watkins agreed and the brewers at once issued a circular saying they had arranged with such and such a firm to supply their first-class cider but their tenants must clearly understand that they were in no way to push the sale of cider. The tenants of the houses at once lost all interest in it. They got nothing out of it, and they did not push the cider. The consequence was the cider makers did less with the 150 houses than with the 15. In many cases brewers do not allow their houses to keep cider at all. Another difficulty which restricts the demand for cider is the large quantity of aerated water sold as champagne cider, or sparkling cider, which does not contain a particle of apple juice. What cider makers would like is a legal definition of "cider," the fermented juice of apples. It will not be easy to get it. Attempts made to get a definition of "beer" have not been successful.

The Acreage in Orchards.—Just as hop growing, and small fruit growing, are desirable cultivations from the point of view of labour, so in a lesser degree is orchard cultivation for the purpose of cider making. Moreover, as with hops, there would seem to be less to fear from foreign competition. It pays the ordinary agriculturist better to grow vintage than pot fruit, and the cultivation employs more labour than the ordinary agricultural or pastoral farming. The acreage under orchard is steadily if not very rapidly increasing, more especially in England. The acreage in orchards in England in 1875 was 150,600; in 1885, 192,344; in 1895, 212,963; in 1904, 233,286. Over the same period it has increased in Wales from 3,052 acres to 3,748, and in Scotland from 1874 to 2,449. Taking Great Britain as a whole, the increase has been from 148,221 acres to 239,483 acres. It can hardly be doubted that the increase would be much more rapid if only the compensation question were satisfactorily solved. Landlords would then be more willing to plant, or to allow tenants to do so. But there is also need of better knowledge on the part of farmers as to the proper treatment of orchards, and a better system of manufacture.

Journal of the Society of Arts.

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FRIDAY, SEPTEMBER 22, 1905.

NOTICES.

"OWEN JONES" PRIZE.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Committee of the Owen Jones Memorial, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates :—

Arndt, Paul, Battersea Polytechnic School of Art, London, S.W.—Design for a Table-centre.

Elkins, Percival S., School of Art, Bath.—Design for Sgraffito Plaque.

Bickerstaffe, Arthur, School of Art, Macclesfield.—Design for Silk Hanging.

May, Margaret E., School of Art, Carlisle.—Design for Wall Tiles.

Hood, Wilfred M., School of Art, Nottingham.—Design for Wall-paper.

Stott, Sarah J., School of Art, Leeds.—Design for Cretonne.

The next award will be made in 1906, when six prizes will be offered for competition.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

TELEPHONY.

By Herbert Laws Webb.

Lecture II.—Delivered March 20th, 1905.

Telephone Lines.

The problem of the telephone line plant has to be studied under a variety of different aspects, and those aspects undergo change as conditions change. In the earliest days the problem was simply one of obtaining effective telephonic transmission over distances of a few miles. Even with the relatively crude line practice which telephony at first adopted from telegraphy, that was no difficult matter. But telephone wires in cities rapidly multiplied, and the distance over which telephonic transmission was demanded rapidly grew; under these conditions it became evident that telephony required totally different line design and construction from telegraphy. As the number of wires required in a given area increased, and the distance over which commercial talking was demanded stretched further and still further, telephone line practice diverged still more widely from that of the telegraph. The massing of wires in large cities made the use of cables and underground conduits a necessity; and this introduced two big problems of practical and commercial importance—the design of telephone cables for underground city lines which should still enable the subscriber to talk over the longest distances which the trunk-line or long-distance system might reach, and the effective and economical distribution of tens of thousands of individual wires from a central building to tens of thousands of individual buildings. This distribution problem alone—

the segregation of a waterspout of wires into a myriad of drops scattered over square miles —might well occupy an evening's discussion. Nor have the limits of the problem ceased to expand. With the growth of telephone development every large city telephone system has become linked to suburbs and other towns by circuits in great number; as the number of these circuits grows it becomes necessary to put them underground. Consequently, whereas ten or twelve years ago we thought we were doing great things in talking ten or twelve miles through underground cables, we now need to talk twenty or thirty miles, and we need cables which will not only talk these distances but will talk when joined on to an overhead line a thousand miles or more long. And all these things must be done at such cost that the results will be commercial.

In telephonic transmission we have three evils to guard against—attenuation, distortion, and induction, or interference. We are dealing with a relatively small current, and although the telephone receiver is so sensitive that it responds to immeasurably small currents, still, attenuation of the received current to an extreme degree means loss of loudness, and a certain fairly well understood standard of loudness is essential for commercial talking. Distortion is even more important than attenuation, since if certain of the waves are displaced or lost in transmission some of the characteristic sounds of speech disappear; there is loss of clearness, speech becomes difficult, and finally impossible. Attenuation is due mainly to resistance, to loss of energy expended on heating the conductor; it is also due to leakage and to capacity, to absorption of energy in charging the dielectric; distortion on the other hand is due to capacity, to the entire absorption or displacement of some of the waves. Induction, or interference by induced or foreign currents, was the great enemy of telephonic transmission in the early days of the industry, when the use of single wires was general. The sensitiveness of the telephone is so great that it responds to feeble currents which would not be noticed on any other commercial circuits. With single wires foreign currents often made telephone circuits wholly unworkable. Even the metallic circuit is not of itself a complete guard against foreign currents. To prevent interference it is necessary that the circuit be evenly balanced, that each side be of equal value in resistance, capacity, and insulation, and that each side of the circuit be equally exposed to sources of interference.

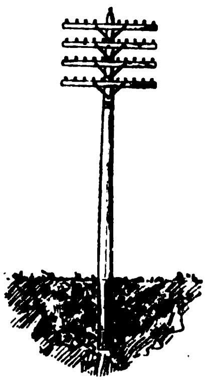
Professor Hughes, in 1879. first pointed out the necessity for an evenly-balanced metallic circuit for effective telephonic transmission, and he it was who devised the twist system of transposition by which the two wires of the circuit, revolving around each other, are equally exposed throughout their length to all external sources of disturbance. This transposition, which results in the induced currents which appear in the two wires neutralising each other and so causing no disturbance in the telephones, is carried out in all telephone metallic circuits. In open overhead wires it is done either by changing the relative position of the wires at every pole, as suggested by Professor Hughes, or by changing their position at certain definite intervals. In cables and insulated wiring of all sorts it is done by twisting the two insulated conductors of a pair together. This transposition or twisting is absolutely necessary to prevent cross-talk, or overhearing by inductive interference, when several circuits are carried on the same supports or in the same cable. With parallel circuits, overhearing or cross-talk from one circuit to another may be as distinct as if the lines were in metallic contact.

In the early days of telephony, in fact, for some considerable period, the balanced metallic circuit was looked upon as a counsel of perfection, at any rate, as far as purely local service was concerned. For some time it was a struggle between correct theories—or, to put it more accurately, correct practice—and commercial necessities. The business as a business was young; it was largely experimental, and there were many difficult problems on all sides; money was scarce, it went quickly and came back slowly. (It is curious that telephone service seems to be the one service which the public, with a remarkable unanimity, has always shown great unwillingness to pay for.) So the single iron wire of the telegraph was at first generally used for the telephone. Gradually various considerations caused the single iron wire to be substituted by the single bronze or copper wire. The low conductivity of iron, its high self-induction, and its great weight caused it to disappear from large telephone systems at a comparatively early date. Still, iron wire has its advantages; it is cheap and it is strong, and for local and short-distance service its low conductivity is no drawback. Where telephone service has to be done very

cheaply, iron wire is largely used to-day; for example, by the small co-operative telephone companies in Scandinavia, and by the rural and small independent telephone companies in America.

In all large systems, first phosphor or silicium bronze and then hard-drawn copper soon entirely superseded iron wire. The invention of hard-drawn copper wire gave a great impetus to the building of long distance telephone lines, as hard-drawn copper furnished a conductor of mechanical strength practically equal to that of iron, and of greatly superior conductivity. Without this useful invention, due to Mr. Thomas Doolittle, of Boston, long distance telephony might have languished many years. With it, the range of the telephone rapidly increased, and, in the eighties, an extensive business in long distance telephony sprang up.

FIG. 14.



AMERICAN TELEPHONE POLE LINE CONSTRUCTION.

The construction of telephone lines differs considerably from that of telegraph lines. Since the volume of business done is greater, and every line consists of two wires, the number of wires in a line or route is usually much greater, and this requires a more economical use of the pole than is customary with telegraph lines. Early telegraph practice placed only two wires on a cross-arm. In telephone lines eight or ten wires are placed on a cross-arm; the usual American practice is ten wires, English practice eight wires. The use of a large number of wires on a line involves the most substantial form of pole line construction; the standard American practice is to place 40 poles to the mile, giving a span of 130 feet, and to stay or brace every pole where any unequal strain occurs. In the early days of long distance telephony in America, it was customary to use very tall poles—poles of 60 and 80 feet were not uncommon—in the endeavour to carry the wires well above other lines and trees. These high poles were not a success, as the leverage of the heavy weight at the top brought them down in the severe snow-storms which are so frequent in an American winter. With wet snow, and any wind at all, the strain is irresistible; I have seen new poles, 14 and 16 inches in diameter at the butt, snapped off or pulled out of the ground by a very moderate fall of snow. As a result of these experiences the general use of very tall poles was abandoned, and the standard pole is now about 36 feet.

The use of heavy copper wire and the systematic transposition of the circuits again differentiate telephone line construction from that of telegraph lines. In order to obtain effective transmission over long lines it has been found necessary to use much more copper in telephone circuits than is used in overhead telegraph circuits. The longest lines in America are built with 435 lb. copper. In Europe, partly because undue value was given to theoretical considerations, partly because the transmitters used in Europe have generally been less powerful than those in use in America, much heavier wire has been used for long-distance lines. Some European lines are built of 600 lb. wire, and the "backbone" trunk from London to Glasgow is of 800 lb. copper. Thus, in talking from London to Glasgow one speaks over nearly 300 tons of copper, worth, for the metal alone, over £20,000. A New York to Chicago eircuit, nearly two and a half times the distance, contains less than 400 tons of copper.

The transposition of telephone circuits is a very special feature of their construction. Unless it is carried out with scrupulous care and accuracy the circuits become noisy and inefficient. In Europe the twist system is used more generally than the transposition or cross-over system. In America the transposition system is used exclusively; so that each method has its adherents. Each gives good results in producing silent lines. A circuit built on the twist system is beautifully silent, but it is very sensitive to any loss of balance. It has one practical advantage over the transposition system in that the method of construction is uniform throughout—each wire changes its position regularly at each pole. In the transposition system the various circuits are transposed at different intervals, the number and distribution of the transpositions

being determined by the length of the line and the number of circuits. This method gives a line of better appearance, since the wires change places only on the cross-arms and not between, and is better adapted to dealing with a large number of circuits; but since the scheme is more complicated it gives more opportunity for mistakes to occur in course of construction and repairs. In either case it is obvious that the building and maintenance of telephone lines require great care and method on the part of the engineering and working force.

Since the capital cost and the earning power of long telephone lines are on such a large scale, it is essential to maintain a continuous service and to avoid serious breakdowns. It is no small feat to maintain in continuous working order overhead lines many hundred miles long, passing through all varieties of country—even through different climates; but long telephone lines are usually so solidly and carefully built that they are the last to go in times of severe stress of weather. In the great American blizzard of 1888, the telephone line between New York and Boston was the only one that stood up. Telegraph business between the two cities had to be done by cable, *viâ* Ireland.

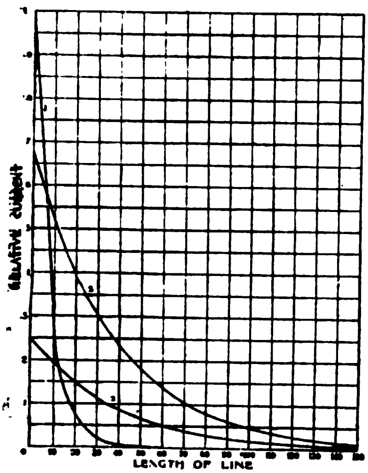
Quite recently a practical solution has been found for the problem which has always faced telephone engineers—the conquest of the attenuation and distortion due to capacity. It has always been recognised that the chief enemy to long-distance telephone transmission was the electro-static capacity of the conductor. In overhead lines, where the capacity is relatively small, the range of transmission has been increased by the use of heavier conductors, thus diminishing the attenuation; but there are commercial and practical limitations to this course, and eventually the effects of capacity assert themselves no matter what weight of copper be used. Mr. Heaviside long ago suggested that inductance might be availed of to counteract the effects of capacity in telephone circuits. Mr. Heaviside's mathematical and theoretical investigations have been of great value to telephone engineers, and this particular suggestion was destined to bear golden fruit in good time.

Professor Sylvanus Thompson, in a paper read before the International Electrical Congress of 1893, enlarged upon the possibilities of using inductances to counteract the effect of distributed capacity. Professor Thompson suggested inductances placed in shunt across the circuit. No experiments leading to any practical results were made, I believe, on these lines, and the original experiments made on the basis of Mr. Heaviside's suggestions were made with lumped inductance and were a failure. It remained for Professor Pupin to discover, by mathematical investigation and laboratory experiment, that the correct method of overcoming distributed capacity is to insert distributed inductances in series in the line. This was a brilliant discovery, one of incalculable value; a contribution to the art of telephony of which science, whether you call it raw or refined, may well be proud. The manner in which inductance coils for increasing telephonic transmission should be made, and their distribution on the line in accordance with its electrical properties, were worked out by Professor Pupin, and the beneficial effect of the use of the coils has been amply proved in practice by much work already done with them by the American Telephone and Telegraph Company.

The loaded telephone line is one of the most remarkable developments in telephony; that the transmission over a telephone line can be markedly improved by inserting inductance coils in series seems so contrary to all previous telephone practice as to be almost uncanny. The use of the terms "loaded" line and "loading" coil, comes from the analogy of the loaded string. A cord loaded with weights, spaced at regular intervals, responds more readily to waves of certain lengths than the same cord unloaded. That represents mechanically the loaded telephone line. Reaction and action must be equal and opposite; the action of the capacity in absorbing a charge is counterbalanced, as it were, by the discharge of the inductance. The absorption of waves becomes equal for all frequencies, and the circuit is rendered distortionless. In actual practice, the loading coils have already achieved most valuable results, although much detailed work has had to be done, as might naturally be expected, in applying an invention of this sort to practical conditions. Not only have the mechanical and electrical design of the coils required much study and experiment, but it has been found in practice that if ordinary telephone apparatus is joined directly to the end of a loaded line there is a large loss from reflection of the waves. To cure this evil, it has been necessary to apply tapered-off loading coils at the terminals; that is, a series of gradually diminishing inductances. Without the taper, the effect is, to use another mechanical analogy, somewhat

akin to that of a brakeless express train arriving full-speed at a station; the taper supplies an inclined plane which checks the speed. From a recent paper by Dr. Hammond V. Hayes, who has done a great deal of work in

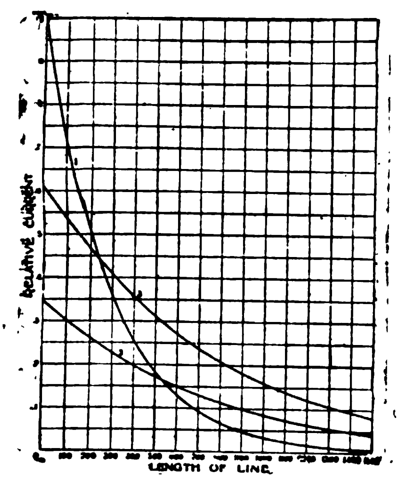
FIG. 15.



EFFECT OF "LOADING" ON CABLE CIRCUITS.

1. Unloaded line. 2 and 3. Loaded lines.

FIG. 16.



EFFECT OF LOADING ON OVERHEAD LINES.

1. Unloaded line. 2 and 3. Loaded lines.

he practical application of the Pupin method, extract two curves (Figs. 15 and 16) which show the results achieved in practice with oaded underground and aerial circuits. The irst curve relates to cable circuits having a oop resistance of 96 ohms per mile, and a loop apacity of ·068 mfd. per mile. Curve 1 shows the result on unloaded circuit, curve 2 loaded circuit without tapers, curve 3 loaded circuit with tapers. You will see that with the loaded circuit with taper terminals the talking is as good over 30 miles of loaded cable as it is over 10 miles of unloaded, and that the transmission at 80 miles with loaded cable is equivalent to that at about 19 miles of unloaded. It is difficult to exaggerate the importance of these results, because unloaded telephone cable to talk 20 or 30 miles, and to serve in connection with long distance working would be commercially prohibitive, both because of the cost of the cable and because of the space it would occupy. Yet cables of such length are becoming absolutely necessary in places where telephone development is high.

The second curve shows the effect of loading on an aerial line of 435 lb. copper. Here it will be seen that the improvement attained by loading is less than with cable circuits, although the curve shows that with loaded line the transmission is as good at 1,400 miles as it is at 700 miles on the unloaded line.

It is a feature of all the curves that the transmission on short lengths of line is poorer on the loaded circuit than on the unloaded, and that the initial current is lower; but the rate of attenuation per unit of distance is less on the loaded line, so that as the distance increases the loaded circuit rapidly becomes the more efficient of the two.

There are several reasons why loading is not so effective on aerial lines as on cable circuits. An important point is that the connection of the coils to open wires decreases the insulation. Also the larger self-induction of open circuits, in which the wires are much more separated than in cables, tends to counteract the effect of the coils. On cable circuits the use of loading coils, besides decreasing the attenuation, effects a marked improvement in the clearness of the received speech; this improvement in quality of speech is not so noticeable on aerial lines. I had an opportunity at New York last year of listening on a cable circuit of 60 miles of No. 16 wire arranged so that the loading coils could be switched in and out. Without the coils the talking was a confused indistinct mumble. When the coils were switched in the talking came up loud and distinct, with an effect that was positively startling. It was computed that the 60 miles of loaded circuit gave transmission as good as would be obtained on nine or ten miles of unloaded. But the real benefit and economy of the loading are appreciated

when it is considered that to get as good transmission over an unloaded cable for the same distance, 60 miles, the cable would hold but nine pairs of No. 4 wire. No telephone company could afford to use such a cable.

The actual coils used on loaded circuits are of copper wire on an iron core; the coil is made ring-shaped, and a coil for the aerial line referred to is ten inches in diameter and about four inches high. The copper resistance is 2·4 ohms, and the inductance ·25 henry. For cable circuits the coils are made of higher resistance, and therefore are much smaller. The exact design and the spacing of the coil depend on the character of the circuit to be loaded.

Telephone Cables.

The growth in the number of telephone wires in cities soon brought about the necessity of placing the wires underground. It then became necessary to design a special type of cable for telephone work. The underground wires in use for telegraph lines were unsuitable for telephone work, being too costly, too bulky, and of too high electrostatic capacity. Some of the very earliest underground telephone work was done with gutta-percha and indiarubber insulated cables. In Paris the telephone wires have always been underground, the elaborate sewer system of Paris providing a ready-made space for stowing away cables. In Paris gutta-percha cables were used for many years. In some of the earliest underground telephone work done in America rubber-covered wires were used. But it was soon seen that rubber and gutta-percha were electrically and commercially impossible for telephone work. It was necessary to have a cable which would give circuits of lower capacity, and would enable a large number of circuits to be put in a small space.

There had been various experiments with cables formed of cotton-covered wires placed in pipes kept filled with heavy oil, notably those of Mr. David Brooks. (One of the difficulties was to keep the oil in the pipe.) Development along these lines led to the production of cables in which the wires were covered with cotton and impregnated with an insulating compound, the whole cable being sealed in a lead pipe. The Patterson cable was the first in which the lead pipe or sheathing was formed continuously by a press on the cable. To a certain extent these impregnated telephone cables were a reversion in type, as the earliest underground telegraph cables were insulated with fibrous materials impregnated with compound and enclosed in a lead pipe. At first cables with straightaway wires were used, but in 1887 a specification for a true telephone cable, calling for wires twisted in pairs, was evolved.

These early telephone cables, dating from about 1887, contained 50 pairs of wires in a 2-inch pipe, and 50 or 52 pairs was for some time the capacity of a duct. Some of the early ducts were 2½ inch, but 3 inch has become the general standard size of ducts used for telephone conduits. The use of fibrous insulation at once brought down the electrostatic capacity of the conductor by 40 per cent. The electrostatic capacity of a rubber or gutta-percha insulated wire is about ·33 of a microfarad per mile; that of the first 50-pair Patterson cable was ·20 of a microfarad. It was realised that, as cotton or paper rapidly absorbs moisture, the insulation of the telephone cable really depended on the continuity of the lead sheath, and much concern was felt as to the effect of "pinholes" and cracks in the lead. Standard methods always die hard, and cables in which each wire was not separately insulated were at first looked on with much suspicion, especially by the makers of rubber and gutta-percha cables. Even telephone cable makers and engineers at first thought that the paraffin or compound filling was an absolutely necessary precaution against the too rapid spread of moisture in the cable, if the lead did go.

I daresay there are many men in the telephone business to-day who are uncertain as to the origin of the term "dry core," and who do not know that the core of a telephone cable was ever otherwise than "dry." As a matter of fact, the dry core came about because some of the filled cables in New York became extremely wet soon after they were put into the ducts. This was due to the proximity of steam supply pipes to the ducts. The heat liquefied the paraffin wax filling of the cables, with the result that the insulation went down and the capacity went up, with a complete disregard of specification figures. To cure this evil it was decided to try "dry core" cable, *i.e.*, cable of the same type without the filling of paraffin or resinous compound. This was considered an extremely risky experiment, as if a hole occurred in the lead sheath the cable would all be dead earthed in an hour or two. But it succeeded perfectly. It was found by experience that a filled cable lost its insulation by absorption of moisture almost as quickly as a dry cable. The fear of dry core disappeared, and it was experimented with extensively,

notably by Mr. Patterson. Paper was found to have a lower electrostatic capacity than cotton, and it was found that with dry core paper cable the capacity was only ·12 microfarad per mile. Consequently dry core very soon became the standard thing, and filled cables ceased to be made. Getting rid of the filling was a great boon to the cable makers, as it was the most troublesome part of the process of manufacture.

Taking advantage of the gain in space, and of the improvements in manufacture which experience suggested, cable containing 100 pairs was very shortly produced, using but a slightly larger diameter—2¼ in.—of lead sheathing, and the carrying capacity of the duct was at once doubled. A few years later, in the early nineties, the manufacture of telephone cables had so far progressed that 200-pair cable of 2½-inch diameter was a standard article. Dry paper had become the staple material for insulation. Much attention was paid to methods of wrapping the paper loosely on the conductors so as to obtain the maximum amount of air space and so a minimum capacity. In this way the electrostatic capacity of the conductor was brought down to ·08, ·07, and even to ·06 microfarad per mile. As more powerful transmitters were introduced, and as conduit space became more valuable, the extremely low capacity was abandoned in favour of a larger number of conductors in a 2½-inch pipe. This was obtained by giving the conductors greater compression and by using a finer wire.

Within ten years of the introduction of the telephone cable 400-pair cable had become a standard type, and the possible capacity of the 3-inch duct had been increased eightfold. To-day 600-pair cable is in regular use, and even 1,000-pair cable has been made for special purposes. The immense increase of carrying capacity which this steady increase in the number of conductors contained in telephone cables has given to the conduit systems may be imagined. It is not too much to say that the development of some large telephone systems would have been blocked long ago if telephone cables had not progressed beyond 50 or 100 pairs, as space could not have been found in the streets for the wires required. The cable makers may well be proud of the ingenuity and perseverance they have shown in making not merely two pairs of wires go where one went before, but eight and even twelve.

Turning now to the construction of cable plants, we have three main features—the conduits, the main cables, and the distributing system. Of the conduits much might be said; their name is legion, and the difficulties they present, especially in very large cities, are innumerable. The earliest telephone cables were laid without conduits, in wood troughs filled up with pitch or cement. The disadvantage of having telephone cables buried solid was quickly realised, and conduits became the rule. Very many different types of conduits have been devised for telephone work, ranging from iron pipe to paper. Creosoted wood ducts were an early favourite, and there has arisen a large family of the tile, earthenware, stoneware, and cement ducts. As a result of general experience, three main types of telephone conduit have survived—iron pipes laid in cement, earthenware ducts, and cement blocks. Each class of material has its advantages, but the conditions under which conduit systems have to be laid down vary so widely that it is difficult to give hard and fast rules. The supremely important point is that the ducts shall be well and truly laid. There are a great many ducts below ground in various parts of the world that through being out of alignment are not doing their full duty. A very small difference at the joints of a 3-inch duct makes it the equivalent of only a 2¾ or 2½, and seriously reduces its carrying capacity. Earthenware ducts, being made in short pieces, are more liable to this defect than other types. On the other hand, they are cheap and they are compact, and when thoroughly well built they become as solid as a Roman wall—even more so, because many old Roman walls were hollow. Iron pipes, being made in long pieces, are less liable to loss of alignment, and, being stronger, are more suitable where only a few ducts are required, or where the ducts have to be spread in layers; in other words they are more flexible. Cement blocks are largely used in Europe, practically not at all in America; they are not so flexible as iron pipes, they require a long length of trench to be opened at once in order that obstructions may be exposed, and they need extreme care at the joints. Broadly speaking it may be said that earthenware ducts have the advantage where many ducts are required in one run, and the obstructions do not impose frequent change in the formation of the conduit; iron pipes come in where obstructions are frequent, and where single ducts or single layers are required, and cement blocks come

in best where obstructions are few. In the Continental cities, where the streets are comparatively little encumbered with other pipe services, cement blocks are very popular, and they have also been largely used in English cities.

An important part of the conduit system is the manholes. A telephone cable unfortunately cannot be laid from point to point like a submarine cable. By reason of its size and weight it has to be handled in comparatively short lengths of a few hundred feet. To facilitate the drawing in and out, and the jointing of the cables, manholes have to be established at frequent intervals along the line of conduits, practically at every important street junction. These, in a large conduit system, become small underground chambers of brick, into which the ducts debouch. They require to be very solidly built, with a roof supported on girders, properly drained, and protected against the ingress of mud and water. The cover is usually made round so that by no possibility can it be dropped down on the cables. Of the drawing in and out of the cables, and the jointing, little need be said. It is arduous and laborious work, especially drawing out. The drawing in is generally done by a hand winch. In America modern practice is to use a motor-driven winch, which materially quickens the work. A wire is usually left in the ducts for hauling through the drawing-in rope, or the ducts are rodded with a set of rods similar to those used by our friend the chimney-sweep. Sometimes a light line is drawn through by a wooden tractor having a leather head which nearly fits the duct. This device is sent through the duct by air pressure, and is technically called a "mouse." The term has given rise to a newspaper story, which frequently appears, to the effect that telephone companies use a tame rat to take a hauling line through the ducts. I believe no rat has ever made himself so useful.

The jointing of gutta-percha cores, especially in submarine cables, is an operation of great solemnity. In the older telegraph text-books you will generally find it described largely in italics. Jointing a telephone cable is partly electrical work, partly plumbing. It is an operation needing much care and method, as several hundred pairs of wires have to be well jointed electrically, and all pairs must be jointed in their right order. In the early days there was not a little trouble from cross connections. The joints in the conductors are covered with little paper sleeves, and when all conductors are jointed the entire splice is dried out with melted paraffin or by heat. The break in the lead pipe is then completed by a short length of pipe, which is made one with the cable sheath by a plumbers' wiped joint at each end.

Some twelve years ago the telephone engineers in Paris, having a lot of defective cable on their hands and a central supply of compressed air available, bethought themselves of raising the insulation of the cables by pumping dry air into them. The process was a great success and has been largely adopted. A dry air pumping plant is now a recognised part of telephone equipment, and portable air pumps are used for testing joints and drying out bits of cable. An air nozzle is attached to every cable at the exchange and at the joint boxes. The air is dried by being passed over calcium chloride, and is forced into the cable at a pressure of about 20 lbs. to the square inch.

The difficulties of building telephone conduit systems in large cities are well illustrated by the character of the work done recently in central London by the Post Office. These views are typical of the difficulties encountered and of the special work which had to be done in order to overcome them. [At the lecture a large number of lantern slides illustrating conduit work in London was shown.]

In negotiating these obstructions many changes in the arrangement of the ducts had to be made. From the Central Exchange manhole ninety ducts start in one direction in three 30-duct conduits, each conduit consisting of six tiers of five ducts. Later on these combine into one conduit of nine tiers of ten each, and a bit further they spread into six tiers of 15 ducts. In one place 90 ducts have to be carried in two tiers of 45 each. There are many other instances where the conduits alternately concentrate and spread out in order to negotiate obstructions. In Queen Victoria-street, the arch of the subway had to be cut away and replaced by a steel roof to provide space to carry the conduits. Needless to say, so much interlacing of conduits with other pipe services and underground works entails much care in the engineering of the work and largely adds to the expense.

Telephone cables laid in well-built conduits are reasonably safe from risk of damage, but the whale which occasionally plays skipping-rope with a submarine cable, the sword-fish or shark which occasionally takes a bite through sheathing, jute and core, the fire built on the

beach which has been known to destroy a shore-end, all have their prototypes on land. A burst water main now and then floods manholes and finds out weak joints. A shark of a navvy now and then dives his pick through duct cable and all. It is a tribute to the solidity of telephone conduit construction that on one occasion a Post Office conduit in London was mistaken for a Roman wall and the persevering explorers drilled through a tier of ducts and cables before discovering that they had tapped twentieth-century civilisation. In New York a year ago a group of telephone cables were destroyed by fire. A large manhole had been taken out to facilitate work on the underground railway, the burlap wrapping put on to protect the cables from accidental blows caught fire, and some 5,000 wires were put temporarily out of service. In some parts of America a curious trouble arises from the freezing of water in the lateral pipes leading from the main conduits to the distributing points. The expansion of the ice crushes the cables and forces the conductors out of their paper wrappings into contact with each other and with the lead pipe. One large telephone company has organised a thawing brigade and equipment to deal with this trouble. The pipes are thawed out by the application of a heavy current, and it is found that when the ice is melted the cable returns to its normal condition. The waggon, equipped with petrol engine, dynamo and step-down transformer, is called in the expressive terminology of Western America, the "juice-waggon."

Distribution.

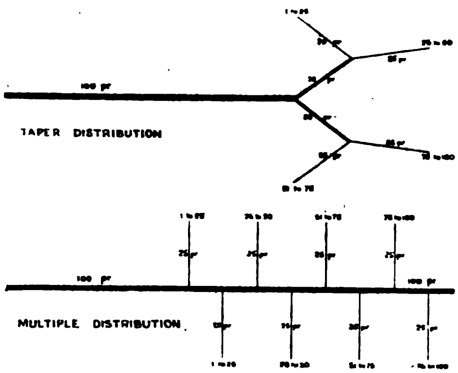
Both from an electrical and from a commercial point of view the most difficult part of a telephone cable plant is the distributing system. It is no light job to split up 5,000 to 10,000 pairs of wires, passing under the streets in large units of from 100 to 500 or 600 pairs, into individual pairs, each pair going neatly and economically to its individual instrument. You may have 10,000 pairs of wires at the exchange in 20 to 25 cables, compact and easily handled. At the outer terminals those cables have to be sub-divided into 10,000 individual pairs of conductors, each well insulated and electrically and mechanically perfect up to the terminals of the sub-station which it serves. The problem has only to be considered for a moment for its magnitude to be appreciated. Apart from the electrical and mechanical difficulties of dealing in this way with a great number of wires, there are considerations imposed by practical and commercial conditions which add considerably to the complexity of the problem. It is not merely a question of carrying a fixed number of wires to fixed points, so to remain permanently. The population of a telephone system is always changing. New users are constantly coming on and old ones are constantly going off. The new ones do not always come on where you expect them or where you want them, or in the proportion that you expect them. Often you provide, say, for 100 at point A and you get only 30, and at point B, where you provided for 25, 60 suddenly appear. Nor do new users always kindly appear at the exact points where old ones disappear. Often when a telephone user goes away the new occupant is one of those curious people who say they have "no use for the telephone." Again, many people seem to spend their lives in moving from place to place. That often means a line thrown spare at one point and another line wanted at the same time somewhere else. To sum up these and other considerations, what is required in a telephone distributing plant is flexibility, so that you can pick up new users wherever they appear and transfer the service of existing users from point to point as they require. This flexibility is only attainable by spare capacity, by having many more wires in the plant than there is actual use for at any given moment. This is one of the important difficulties and sources of expense in telephone work. But it has to be faced from the very beginning, or a state of blockade soon arises which is most disadvantageous. In all large city telephone systems, where development is provided for, you will find that taking the cable and conduit plant right through, not much more than 50 per per cent. is in use. Wherever there is only a small margin of spare capacity an accompanying feature is that many people have had applications for telephone service on file for long periods, that there is great public dissatisfaction, and that the business is carried on under artificial and unsatisfactory conditions.

In the early days of telephone cable work the spare capacity was carried right through the plant. The cables were split up and tapered down so as to carry a few pairs to each of a number of distributing points. Experience showed that this was building the cable plant upside down, that the flexibility was wanted above all in the distributing plant, and that the best economy and flexibility were attained by using large main cables and

by putting the spare capacity in the distributing cables. In this way main cables and conduits are used with relatively high efficiency, and, with several distributing wires for each pair of conductors in the main cables, any main cable pair may be extended to any one of several different points, which gives the necessary flexibility.

This is done, broadly speaking, in two different ways: by multiple distribution—that is, by tapping from the main cable the same pairs at two or more points—and by terminating at junction or distribution boxes a

Fig. 17.



Taper and Multiple Distribution.

larger number of distributing conductors than main conductors. The distributing cables are carried through the buildings to be served, and split up at distributing boxes into smaller cables as required.

Several different ways of direct underground distribution have been worked out in practice. In America many types of distributing ducts, with direct pipe connection to the houses to be served, have been tried. The principal objection to distributing ducts is their high cost. In New York a method has been worked out called the "block distribution" system; a main cable is carried into a block of buildings and connected to a junction box, and from this junction box radiate distributing cables, which are carried through the cellars and along back walls to small distribution boxes, from which single pair conductors can be taken as required. A somewhat similar system is used in Sweden and in the new work in Moscow and Warsaw. In the London Post Office system the distribution is done by means of pavement ducts and handholes or small joint boxes. To the main cables are connected, by means of special distributing boxes, groups of 7-pair distributing cables, and to these 7-pair cables are jointed single pair cables which go directly into the subscriber's premises through an iron pipe. This is very complete and substantial work; it costs a great deal, but the British taxpayer can afford to do things which a commercial concern would have to think twice over. And the great advantage of such work is that once done it is there as long as the street and the buildings are.

Fig. 18.

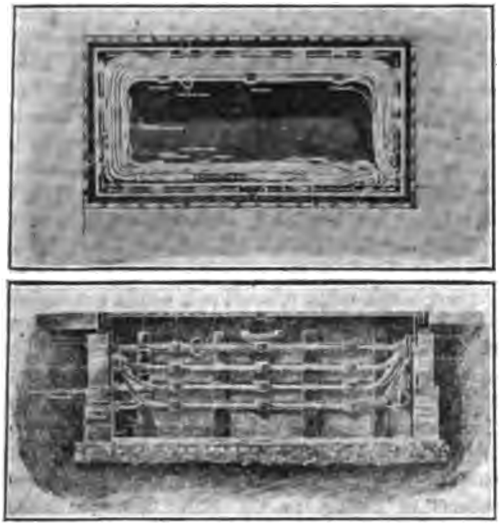
Distributing Box in Moscow. Main Cable 300-pair, Distributing Cable 60 10-pair.

In the Russian, or rather the Swedish system, the main cables, generally 300-pair, are taken to street distributing boxes, and from each box sixty 10-pair cables are taken to the neighbouring buildings, thus giving double the capacity in the distributing system that is contained in the main cables. The 10-pair cables are headed up to small wall distributing boxes from which 1-pair cables run to the instruments. Some distribution is done from roof fixtures and from iron distributing poles.

In small places where conduit work is too expensive, aerial cable distribution is now largely used. Pole lines built with cable are much less conspicuous than when built with open wires, and the cable lines maintain the

high and uniform standard of insulation required in common battery working. Cables are headed up and distribution done by ring or framework supports, sometimes with open wires, sometimes with 1-pair cables.

FIG. 19.



PAVEMENT DISTRIBUTING BOX.
(London P.O. System.)

FIG. 20.

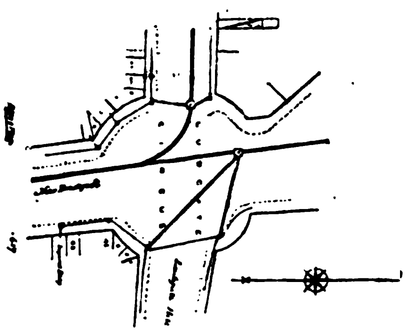


DIAGRAM SHOWING DISTRIBUTION FROM MAIN CONDUITS TO PAVEMENT DISTRIBUTING DUCTS, AND FROM DISTRIBUTING DUCTS TO SUBSCRIBERS' PREMISES. (London P.O. System.)

Summarising the evolution of the line plant of a city telephone system we see that it can be divided into four periods. In the first the line plant was entirely overhead and consisted principally of iron wire and single circuits with earth return. The second period was the transition from earth working to metallic circuit and from overhead to underground construction. During this period the plant consisted of copper wires, partly metallic circuit, partly earth circuit, and partly underground and partly overhead. In the third period we find the working exclusively metallic circuit and the main cables all underground, the distribution only being effected by means of overhead work. In the present period the standard of work in cities is a complete underground system with direct underground distribution. It is only in the outlying or suburban parts of a large city that modern practice countenances overhead distribution.

THE FRENCH CALCIUM CARBIDE INDUSTRY.

The principal centres of the calcium carbide industry in France are in the Alps and Pyrenees, particularly in the environs of Bellegarde, Grenoble, Nice, and Toulouse. At present there are eleven manufactories capable of producing 40,000 tons of calcium carbide annually. The demand is far from corresponding to the means of production, and the total output sold during 1904 may be estimated at 18,000 tons. The average yield of gas per unit of weight of carbide is about 40 gallons per pound. According to the American Consul at Marseilles, there appears to be no market properly speaking. The French manufacturers are completely protected against importations by the Bullier patent, and manufacturers of carbide and acetylene have arrived at an understanding whereby an average price has been established which enables both industries to exist. The manufacturers of carbide are said to lower their price every time they are able to do so without inconvenience to themselves. The merchandise is packed according to the wish of the buyer, in tins of 220, 143, and 110 pound capacity, or in case of shipment for exportation, in wooden cases lined with tin. Sales are controlled by the Société Commerciale du Carbure de Calcium, with headquarters in Paris. This company has a capital of £88,000, and has been chosen by the eleven producing concerns as their selling agent for the entire country. The cost price per ton of calcium carbide in Europe was estimated by Professor Lefevre, of the Ecole des Sciences, Nantes, in 1897, at from £8 to £10. There was nothing then, so he stated, to indicate the probability of these figures being sensibly modified. M. Pictet, however, in the same year, thought that the product might be made at the cost of a little over £3, by the use of a new furnace. Theoretically, said Professor Lefevre, one pound of calcium carbide ought to produce, by its action upon water, about seven ounces of acetylene. It has been stated by one of the most important of the French firms included in the Trust, speaking of the production of 1904, that this was disposed of at £8 per ton, the standard accepted and declared being about forty gallons of gas per pound. The product

at the factory realises £8 per ton, and the rate for the retail dealer is £14. These figures demonstrate the advances made in manufacturing since the publication of Professor Lefevre's treatise in 1897. Professor Lefevre concluded his study of the subject, as follows: "What is the future of acetylene? Is it destined, as certain of its defenders affirm, to supplant all other illuminants, and become the one source of light? It is difficult to foretell the future, but a complete triumph does not seem probable. Moreover the cost will certainly play an important *rôle*. The development of illumination by means of acetylene gas is subordinate to the selling price of calcium carbide. Acetylene has to fight against two powerful rivals. Coal gas, thanks to its numerous by-products, often permits of the establishment of prices so low as to defy competition. Electric illumination has also numerous advantages, even when more expensive, as, for example, intensity, security, preservation of the purity of the atmosphere, suppression of smoke, odour, &c. Acetylene gas, now, is distinguished by the simplicity of its preparation, and is therefore adapted to installations where the number of burners is too small to justify the erection of a gas plant or electrica station. It is specially adapted to hotels, villas, farms, isolated houses, ships, &c. For the same reason it may be employed in trams and railway carriages. There appears to be a long series of applications especially reserved to acetylene gas which assure it a special place in the list between its two principal competitors, gas and electricity."

TREES, HERBS, AND ROOTS IN WEST AFRICA.

Professor Abayomi Cole was instructed by the Governor of Sierra Leone to collect and report upon botanical specimens—herbs, roots, &c.—to be found in the forests of the West Coast of Africa, and his report has been received, and the following notes are obtained from it. The author points out that the economic and medicinal value of African forests are little known to the European world. Every year thousands of acres of forest lands, containing useful plants and trees, are destroyed, the loss of which is far greater than what may be gained in the single year's production of rice or corn, and the intelligent collection of which might have added greatly to agricultural profits, and made the forest lands more valuable. As an aid to the scientist who may not have seen the plants collected by Professor Cole growing in their native soil he has, in a few cases, furnished botanical or analytical notes along with his report.

The Khalmatamba is one of the most remarkable of West African forest trees. It is one of the African mystical medicine trees. The name, Khalmatamba, is of Susu origin. It is called "Orbai," the king (of trees), by the Timenes, and amongst many tribes sacrifices are offered to it. It is believed to have the power of curing every malady, and there is no important medicine (or greegree) of which it does not form a component part. It is known among the Mendes as Sowe-pue-ite, "Bondo matron's rod," as, on account of its sacredness and medicinal potency, the wand carried in procession by the leader of the Bondo (Women's Secret Society) Order is generally made from it. It has not been employed, to Professor Cole's knowledge, as medicine by any European doctor. The parts used by the natives are the bark and the leaves, and a fixed oil obtained from the seeds is a remedy used in cutaneous affections. This plant is employed as a "cure all," but specially it is the secret medicine of the Bondo doctors in the treatment of uterine disorders, and in many cases, the Professor says, it has been quite efficacious.

Professor Cole has collected beans from the Kundi tree (Nat. Ord. Meliaceæ, *Carapa guineensis*) and obtained oil from them. This oil is a specific in various kinds of skin diseases. It is very valuable in the progressive stages of small-pox, or as a preventive when combined with the powdered bark of the Fue tree. Its efficacy in some inland towns of the Protectorate, where no vaccination was performed during the recent small-pox epidemic, was, the Professor says, well marked. It is also anthelmintic, and an infusion of the bark is used for the cure of indolent ulcers. The Fue tree, referred to above, appears to belong to the Nat. Ord. Rutaceæ, *Xanthoxylon*. It is used by natives for cold, catarrh, hoarseness, and is a permanent and energetic stimulant. It is a specific for toothache.

The native tea (Efirin—tea bush, *Ocymum viride*), which belongs to the order of the Labiatæ, is described by Professor Cole as "diaphoretic, aromatic, with an astringent tendency following its primary laxative actions. It is also a diffusible stimulant. It is the African household remedy in colds and ordinary fevers, and is employed to allay the irritation of the gastro-intestinal mucous membrane. The active property is contained in a volatile oil, which could be seen through the leaves in dotted small glands if held up to the light. It is suspended in sleeping apartments to check the approaches of swarms of mosquitoes." The Professor says that the plant has undoubtedly properties which, whilst they may not avert the ingress of the mosquito altogether, decrease their numbers as soon as it is suspended in the apartment. The irritation and inflammation caused by the bite of the anopheles and other small flies are allayed in a short time if the distilled extract is applied over the parts. Professor Cole says that "this remedy will in due course be found a reliable prophylactic for malaria if not a cure for the disease." Tea is prepared from the fresh herbs.

Kimboyufe (Nat. Ord. Compositæ) is the specific for African yellow fever. It is employed in febrile diseases, and as a diuretic in dropsy connected with diseased kidneys. Professor Cole considers it a reliable remedy for "black-water fever." The powdered root is used as snuff in catarrhal affections, and taken internally it is also laxative and diuretic,

preventing waste and excretion. In the Professor's opinion "it demands careful investigation," and he has prepared and forwarded for examination 4 lbs. fluid extract of the fresh herbs.

One of the most important and valuable plants in West Africa is the Ojuologbo—Woody Vine (Nat. Ord. Rubiaceæ). It is used us medicine by nearly all West African tribes. It is the proper anti-malarial specific that has kept its reputatiou as such, on the Continent, for centuries, for it is noted down as a "valuable blood maker or purifier," and "fever expeller" in an ancient Sudan medical Arabic manuscript, written several centuries ago where the plant is mentioned as "Humidtaradu." It is a gentle stimulant to the cerebro-spinal centres, acting on the kidneys and urinary apparatus, inducing waste and excretion, improving digestive and nutrition, conditions indispensable to good health in tropical and malarious regions. Ira-igbo is a large forest tree used by natives to allay the spasmodic actions of tetanus, and as sedative in the excited conditions caused by insanity. It produces prolonged sleep, and is dangerous in physiological doses, when it may cause temporary paralysis or death. Rere belongs to the natural order Leguminosœ, Cassia Occidentalis, and its seeds, are used as coffee. They have beneficial effects on the kidneys and bladder. The leaves when ground and mixed with palm oil are applied on children as a remedy for convulsions. Virulent cases of ophthalmia, due to venereal taints, have been cured by the application of the juice of the fresh herbs to the eyes. The root is a specific for gonorrhœa, and is used for "black-water fever" and malarial dysentery.

TECHNICAL EDUCATION IN AUSTRALIA.*

The necessity for providing the means of imparting technical education has been unreservedly acknowledged in each of the States of the Australian Commonwealth, the annual combined expenditure in this direction being over £60,000, exclusive of the cost of land, buildings, &c. In Sydney, after successful experiments in the formation of classes by one of the State subsidised educational institutions in Sydney, a technical education board was established, which did good work until 1889, when the State Government assumed control of the movement, the work of technical education being handed over to the State Department of Public Instruction. The Technical College, forming the headquarters of the system, is one of the leading architectural features of Sydney. The fronts of the main structure are ornamented with Romanesque carvings in white stone, showing representative flora and fauna of Australia. The main entrance is formed by a triple arch, with two centre columns of polished bluestone or trachyte, flanked by two pilasters of the same material. The main building to which access is thus gained has three floors and a half-basement, and contains 28 rooms, many being well lighted, lofty, and suitable class-rooms. There is a chemical laboratory, and at the rear of the main structure are electrical engineering, plumbing, sanitary engineering, blacksmiths' shops, and well-equipped general engineering shops. In 1903 there were 477 technical classes in operation, of which 243 were held in Sydney and suburbs, and 234 in the country districts, while there were in addition 86 classes held in connection with the public schools. The number of individual students under instruction during the year was 13,232, and the average weekly attendance 8,671. In 1896 a technical college was opened at Newcastle, and a new college at Bathurst in June, 1898. In 1902 a technical school was built at Lithgow, and mechanical engineering shops provided at Newcastle. During the year the expenditure by the Government on technical education amounted to £26,459, exclusive of expenditure on the Technical Museum and branches. Fees to the amount of £8,707 were received from the students. In Victoria much has been done in promoting the work of technical education, a patriotic Victorian having assisted the earlier stages of the movement by giving £15,500 towards the establishment of a working men's college. In 1903, there were eighteen schools of mines and technical schools receiving aid from the State. The total State expenditure during the year was £16,430, and the fees received from students amounted to £11,741. The average number of students enrolled was 3,173. In addition, classes in manual training and in cookery and domestic economy are held at various centres, the net expenditure on these branches amounting in 1902-3 to £3,437. In South Australia the Adelaide School of Design in 1903 had 577 students. There were also branch schools at Port Adelaide and Gawler. The School of Mines and Industries, founded in 1889, received State aid in 1903 to the extent of £3,658, while the receipts from fees and sale of materials to students amounted to £3,691. Queensland is beginning to display increased interest in the movement, a board of technical instruction having been appointed in 1902, holding its first examination at the close of 1903, when 960 students were examined, two-thirds obtaining certificates of competency. In the same year there were twenty technical schools distributed through the State, with an enrolment of 2,600 students. The amount of fees, &c., collected was £13,385, and that of the expenditure £14,280, showing the system to be almost self-supporting. In Western Australia a technical school has been opened at Perth, having now an average attendance of 190, the annual expenditure amounting to nearly £6,000. Tasmania has also technical schools in Hobart and Launceston, the average attendance, including that of the two Schools of Mines, being 540, the annual expenditure being under £3,000.

* Communicated by Mr. John Plummer, of Sydney.

HOME INDUSTRIES.

Honiton Lace.—There has been an interesting correspondence in *The Times* respecting the decay of the Honiton lace industry. The fact is indisputable, and the causes various. The Education Acts have had something, perhaps a good deal to do with it. Young girls have to be punctual at the schools, and parents are fined if they are kept at home. Then fashion plays its part. Of late, Irish laces and embroideries have been in favour. And price is always one of the factors that account for a decaying industry. Not only is the market flooded with the cheaper kinds of Belgian, which an uninstructed public buy as "Brussels," but the remuneration of the lace workers at Honiton has been miserable. There are no direct dealings between the Honiton worker and the buyer of her lace. The worker sells to the dealer, the dealer to "the trade," the trade to the public. The public pay a high price for Honiton lace, but the women who make the lace can only earn a pittance at it, although Honiton lace-making is a difficult and delicate art. It has been said that the secrets of the trade are no longer taught, and that the County Council of Devon are neglectful of their duty in this respect. These statements are not supported by evidence. On the contrary, Mr. Kennet-Weir, who is chairman of the Lace Sub-Committee of the County Council of Devon —a position that is in itself an answer to the charge— says that the Council have "entrusted an annual sum of money to a sub-committee composed of county councillors and ladies interested in the art, who have engaged a competent instructress, and have established classes in various centres by whom a great deal of excellent work has been done. The classes are generally well attended, and many requests for the establishment of others have been received." Nor is it correct to say that the younger workers have no longer a knowledge of those intricate and difficult stitches employed in the manufacture of Honiton lace.

Better Organisation Wanted.—It must always be a matter for regret when a home industry, which can be pursued without serious outlay for plant, and which enables the worker to add to a scanty income by labour that does not take her from home, or interfere with her ordinary duties, decays and dies. But the remuneration must have some relation to the work, and this it has not at Honiton. Cannot the middle man be eliminated? Mrs. Ada Slack, the joint honorary secretary of the Diss Association of Workers in Honiton Lace, says that four years ago a small number of ladies belonging to Diss "conceived the project of introducing into their own neighbourhood an industry that should enable women to earn money within their own houses without the need of leaving their domestic duties," and they decided that lace-making best met the want. Thereupon they formed themselves into a committee and began the making of Honiton lace, which has been so successful that at the Home Arts Exhibition last May sixteen Stars of Merit were awarded to their Association. But the lace made at Diss escapes the middle man, and so the worker is able to secure a wage worth working for. Cannot the ladies of Honiton form a similar Association? It at Diss, why not at Honiton?

The Bee Exhibition.—The Bee Exhibition at the Crystal Palace which closed on Saturday serves a useful purpose in reminding the many thousands who visited it of the possibilities of bee culture. With the growth of the acreage under fruit bees are more than ever necessary. One of the drawbacks to fruit-growing is the unfruitfulness of trees. It is due to many causes, and not least to insufficient bees to fertilise the blossoms. Rain very often occurs during the blossoming season and washes the pollen away from the blossoms, and insects, particularly bees, are necessary to fertilise. They are necessary, too, for the cross-fertilisation of the blossoms. Certain fruit trees are self-sterile, that is to say, they require pollen from other trees to fertilise the blossoms. And this self sterility is more noticeable when fruit trees are planted in large blocks, with one variety of apple. In California they have found it necessary to plant other trees, which they call pollenisers, to provide the pollen for fertilisation. They generally plant these trees in rows among the other trees, and they have, of course, to select trees that flower about the same time, so that the insects can carry the pollen from one tree to another and so fertilise the blossoms. For example, two apples are grown very extensively in California, the Bellefleur and the winter Pearmain, both very fine apples. The time of flowering is twenty-six days for the Bellefleur from the time the first blossoms open until the last blossoms drop. In the case of the Pearmain the period is twenty-four days. These apples planted by themselves are very shy bearers; probably only one bud in ten would set. Therefore they plant other trees as pollenisers. The one used very extensively is the Astrachan, because it blossoms with the Bellefleur for twenty-two days, and blooms eighteen days at the same time that the Pearmain blooms.

The Bee as Fertiliser.—The bee is more useful and effective for carrying pollen from one variety to another than other insects, because in the spring, when fruit blossoms have to be fertilised, there are more bees flying than any other insect. It is reckoned that there are twenty bees to one of other insects. These might perform the same office, but they are not on the wing at that particular period. Nor is it only apples that are fertilised by the bee. They serve the same purpose with other trees, pears, cherries, plums, especially pears. And with small fruit too, strawberries produce much more abundantly if they are fertilised by bees. The bee has to work round the strawberry blossom. There are no less than 200 fertilisations of a large strawberry to

get a perfect fruit, and a strawberry hard and green on one side shows imperfect fertilisation. It follows that all fruit growers should keep bees. Mr. T. W. Cowan, who represented the British Bee Keepers' Association, told the Departmental Committee on Fruit Culture, in his very interesting evidence, that there ought to be at least one hive per acre of fruit. Of course wild bees are as useful as the others for fertilising the blossoms, but with cultivation wild bees become exterminated. When orchards are properly cultivated there are no wild bees found in them. The ground is ploughed up and the bees are not able to make their nests in the ground, so that the number of wild bees is reduced, and their are fewer insects for fertilisation.

Bees at Toddington and Histon.—The fruit-growers as a body are not sufficiently alive to the necessity of bees for the purposes of fertilisation but some have recognised their value, strikingly proved at Toddington, in Gloustershire, where a large acreage was put down to fruit some twenty years ago by Lord Sudeley. The orchards on the property were suffering from unfruitfulness. The trees were almost a failure at one time, until Lord Sudeley introduced bees, when the trees soon began to bear freely. Another illustration of the usefulness of bees in fruit grounds may be taken from the experience of Mr. John Chivers, at Histon, near Cambridge. He is the well-known jam manufacturer, and began keeping bees with the object of benefiting his fruit, and he has found them directly profitable apart from their service to his trees. In 1903 he got about 4,000 lbs. of honey, and made £100; last year he got 9,000 lbs.: probably this year the product will show still further increase; so that the bees not only serve a useful, and, indeed, necessary purpose in fertilising the fruit, they pay handsomely in honey for the trouble and cost of keeping them.

Bees a Profitable Home Industry.—Bees provide a very profitable home industry. A case is within the knowledge of the present writer of an agricultural labourer who has been able to buy a freehold cottage out of the profits of bee-keeping. It may be interesting to note how it works out. Take the most primitive kind of hive, the common straw hive or skep, which will long be used by villagers from its easy make and small cost. The cost of the skep may be put at 2s., and 1[redacted]warm to put into it. Other charges do not excee[redacted]king 14s. in all. The cost of feeding is small. Altogether the outlay for the year is probably covered by £1. In a good season one skep would produce 20 lbs. of honey, which the villagers would sell retail at 8d. per lb., say 15s. Next year the one skep has become three, and the revenue has increased from 15s. to £2 5s., which is mostly profit. It will be seen that in four or five years, with ordinary good fortune and natural increase, the villager would be putting aside several pounds per annum as profit. He can always get a sale for his honey. The man referred to above made his own market by working up a connection in his immediate neighbourhood, but even if competition has to be reckoned with, the village grocer is always ready to buy, and the wholesale price never falls below 6d. per lb.

If bar frame hives are used, the production and consequent profit are greatly increased. The produce from the hives is often from 40 to 60 lbs. Mr. Chivers's average last year was 50 lbs., and from one hive 150 lbs. was taken. Put the average at 50 lbs., and the wholesale price at 6d., that means 25s. from each hive, of which at least £1 would be profit. Bees can be kept in almost any part of the country, but they do best where they can get at sainfoin or white clover. It is astonishing that villagers do not more generally add to slender wages by keeping bees. The original outlay, as has been shown, is trifling, and looking after the bees is a pleasant occupation, making but slight call upon exertion, and the profits are large. Bees are subject to few diseases, "foul brood" being the most common and fatal, and it is highly contagious, but it is seldom found where the bees are properly cared for, and kept dry and clean.

The Letchworth Exhibition.—On Saturday last the awards were announced and prizes distributed in connection with the exhibition of cheap cottages erected at Letchworth. It has been a useful exhibition, directing attention to the very important question of rural housing, and although many of the model cottages put up are not suitable for an agricultural labourer's wants, others meet them. It cannot, however, be said that the exhibition has demonstrated that these particular cottages can be erected in the ordinary way for £150. Builder's profit, architect's fee, cost of carriage of materials, have been excluded, and it is idle to speak of actual cost without reckoning these. Moreover, vexatious bye-laws have to be taken into account. As was mentioned recently in the *Journal*, in 1863 the Society of Arts offered special prizes for designs for cottages for the labouring classes, the prizes to be "for the most approved designs for cottages with three bedrooms in each, to be built singly or in pairs, at a cost not exceeding £100 each." And it may be mentioned that Mr. Frederick King, a well-known fruit-grower of St. Ives, Huntingdon, told the Departmental Committee on Fruit Culture that he builds cottages for his labourers at a cost of £100 only, these cottages having three bedrooms and two lower rooms. It seems regrettable that wood is not more commonly used. It is found to answer well in the severer climate of the United States, and it is much cheaper than the materials now generally used in England. No doubt rural by-laws stand in the way, but there is ground for hope that before long the local authorities will be induced, in one way or another, to relax present restrictions upon rural cottage building.

OBITUARY.

Sir Wyndham Portal, Bart.—Sir Wyndham Spencer Portal, late chairman of the London and South-Western Railway Company, died on the 14th inst. at Malshanger, his Hampshire seat. He was born on July 22, 1822, and was educated at Harrow and the Royal Military College, Sandhurst. He was the son of Mr. John Portal, of Laverstoke, and succeeded his father in 1848 as proprietor of the Bank Note paper mills at that place. He was a cornet of the North Hants Yeomanry Cavalry in 1842, and captain 1853-65. In 1861 he was elected a director of the London and South-Western Railway Company. He became deputy-chairman in 1875, and succeeded to the chairmanship in 1892. The latter office he resigned in 1899 on account of increasing age, but he retained a seat on the Board until 1902. He was created a baronet in 1901 for his public services, and in recognition of his life-long labours for the improvement of the condition of the people. Sir Wyndham was elected a member of the Society of Arts so long ago as 1850, he held the office of vice-president in 1891-92, and as a member of the Council became a member of the Royal Commission for the English Section of the Chicago Exhibition of 1893. He had previously been Juror for several of the great exhibitions (Paris 1855, 1867, London 1862, Vienna 1873, and London Inventions 1885). From the Commissioners of the Exhibition of 1851 he received a medal "for services rendered."

GENERAL NOTES.

School of Art Wood-carving.—The School of Art Wood-carving, South Kensington, which now occupies rooms on the top floor of the new building of the Royal School of Art Needlework, in Exhibition-road, has been re-opened after the usual summer vacation. Some of the free studentships maintained by means of funds granted to the school by the London County Council are vacant. The day classes of the school are held from 10 to 1 and 2 to 5 on five days of the week, and from 10 to 1 on Saturdays. The evening class meets on three evenings a week and on Saturday afternoons. Forms of application for the free studentships, and any further particulars relating to the school may be obtained from the manager.

Turquoises.—In his report on the trade of Khorassan for 1904-5, Major Sykes, His Majesty's Consul-General, and Agent of the Government of India in Khorassan (No. 3499, Annual Series), refers to the famous turquoise mines at Nishapur. The mining is utterly primitive and unscientific, and owing to that, and to the fact that every Russian desires to possess a turquoise, good stones, Major Sykes says, are dearer than at a London jeweller's, but inferior qualities and matrix rule lower. There is a considerable export of large, light stones of a milky hue, or containing white veins, to India. These sell at most at 6s. per stone, and are generally speaking much cheaper, being valued in some cases as low as 1s. Stones known in Europe as matrix, which are termed arabi at Meshed, are exported in considerable quantities to that country. Prices rule slightly higher than the Indian stones owing to the demand from Europe which has sprung up during the last two years.

The Naples Aquarium.—The work on the new wing which is being added to the Stazione Zoologica is now, says Mr. Consul-General Neville-Rolfe, in his report on the trade of South Italy (No. 3496, Annual Series), making rapid progress. When completed the capabilities of the institution for scientific investigation in connection with fishing and other questions will be more than doubled, and the extension would seem to be much wanted, for during the spring months of the present year no less than 70 naturalists of all nationalities were engaged in various researches, and 15 applicants had to be refused admission on the account of the lack of accommodation. The completion of the new building, the ground plan of which measures 110 by 77 feet, will permit the following improvements to be made:—(1) The unique library of books on marine biology will be brought together upon the same floor instead of being distributed in various rooms; (2) laboratories and workrooms equipped under the superintendence of Dr. Henze for research in the physiological chemistry of marine animals will be the best and largest of their kind. They will occupy the second floor of the new building; (3) laboratories and workrooms for other physiological work in connection with marine animals will occupy the first floor; (4) a new photographic and artists' room will be gained; (5) a bacteriological laboratory; (6) some thirty new rooms for private study. The basement will be occupied by enormous aquaria and tanks, with the necessary engines for working the circulating pumps and for supplying power to the engineer's shop.

The Condition of Crete.—Mr. Vice-Consul Lascelles, reporting from Canea under date August 18, 1905 (No. 3494, Annual Series), gives a deplorable account of the condition of Crete. From want of means the inhabitants are unable to buy the necessary implements to cultivate their land. The condition of the port is going from bad to worse. It is filling with sand, and is already so barred that only small sailing boats can enter; steamers and large sailing ships have to anchor in the roadstead, and during the winter months they are often obliged to leave it owing to the prevalent north winds, and discharge their cargo at Suda. Improvement in the means of communication is a vital question for the island, but the only work worthy of mention is the construction of the bridge of Petiè, and a few small roads in the neighbourhood of the town.

Journal of the Society of Arts.

No. 2,758. VOL. LIII.

FRIDAY, SEPTEMBER 29, 1905.

NOTICES.

EXAMINATIONS.

The Programme for 1906 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The subjects include: — Book-keeping, Accounting and Banking, Shorthand, Typewriting, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 2, 1906.

The last day for receiving entries is February 28th.

The special subject for Commercial History and Geography is:—Eastern Asia, including the whole of the Chinese Empire.

The only alteration of importance in the Examinations for the present year is in Shorthand. Formerly all the different Stages of Shorthand were taken on the same evening. The different Stages will now be taken on two evenings: Advanced (First-class 150, Second-class 120 words per minute), and Elementary (50 words) on one evening; Intermediate (First class 100, Second-class 80 words per minute) on another.

Swedish has been added to the list of subjects in Stages II. and III., and the examination in Danish will in future be in Danish and Norwegian.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

CANTOR LECTURES.

Mr. Henry Willock Ravenshaw's Cantor Lectures on the "Uses of Electricity in Mines" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures, which have been published separately and are still on sale, can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

TELEPHONY.

By Herbert Laws Webb.

Lecture III.—Delivered March 27th, 1905.

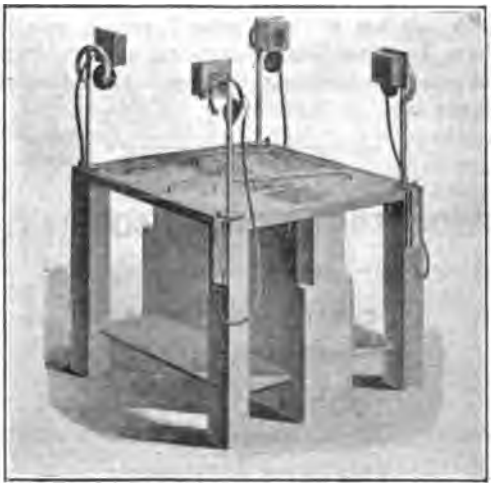
Telephone Exchanges.

Shortly after the telephone was invented and was proved to be a practical method of communication. the idea was conceived of combining the individual lines on which telephones were first used into exchanges, so that any line of a group could be connected to any other. The existing appliances for the purpose of combining lines together were telegraph switchboards, and the earliest telephone switchboards were simply adaptations of the appliances used in telegraph offices for interconnecting different lines with different instruments. The simplest form of telegraph switchboard was an assembly of brass strips, series of strips being placed at right angles to each other in such a way that any two strips could be connected by a pin. It was soon found that the functions of a telephone switchboard were much more complex than those of a telegraph switchboard. In the latter the requirement was to connect a certain

line to a certain instrument for a long period of time, and telegraph switchboards were usually not employed for the purpose of connecting one line to another.

In the telephone switchboard it was required to join any two of the lines at any time for very short periods, and the further requirement existed of receiving signals to indicate the desire for communication and to indicate the end of a conversation. It was further necessary that the attendant in charge of the switchboard should be able to send signals to the instruments at the distant ends of the lines in order to call the attention of the persons using the telephones.

FIG. 21.



EARLY LAW SWITCHBOARD.

The earliest form of signal used was an electro-magnetic indicator of a similar form to that used for electric bell purposes, and the earliest form of signal at the telephone instrument was the ordinary trembling bell. In the earliest days of telephone switchboard working, signals and bells worked by primary batteries were a great source of trouble, and one of the earliest special methods of working telephone exchanges was devised with the object of avoiding the use of signals altogether. This was the system called the "Law" system, so called because it was first put in use by the Law Telegraph Company, of New York. In this system a separate wire was used for transmitting the orders from the subscriber's telephone to the operator at the exchange, the subscriber speaking directly to the operator (who listened permanently on the order line) whenever he wanted to be either connected or disconnected. The complicated organisation of a telephone exchange system has been aptly compared to that of the human body, and in the Law system we get a very good illustration of this analogy. The special call-wire or order wire corresponds to the sensory nerve, and the individual wire of the subscriber's line to the motor nerve. A message is first transmitted along the sensory nerve, so to speak, and the result is afterwards obtained by manipulation of the motor nerve. The use of the Law system, involving two separate wires to each subscriber's station, one wire being common to a number of stations, was continued for a few years, but the radical disadvantages of the system, arising from the use of a large amount of extra line plant and from the numerous special methods of working required, prevented its general adoption and eventually caused it to disappear entirely from practical telephone work.

The majority of telephone engineers have worked on the lines of obtaining definite signals to indicate to the operator the progress of each step in the connection. The first type of signal, as has already been said, was the ordinary electro-magnetic indicator. This was operated at first by means of a primary battery placed at the subscriber's station, and later by means of a magneto generator, which would also serve in case of necessity for ringing the bell of the distant subscriber.

There was very rapidly developed a special type of telephone switchboard which departed entirely from the form of apparatus used for telegraph switching. The pin and strip were displaced by the flexible cord terminating in a metallic plug and the "spring jack" or socket switch, to the springs of which the telephone line was connected. By the insertion of the plug in the socket of the spring jack the metallic parts of the plug made contact with the contact springs of the spring jack, thus establishing a temporary connection between the telephone line connected to the springs and the metallic conductors in the cord attached to the plug. At the same time advantage was taken of the separation of the springs of the spring jack to disconnect temporarily the indicator from the line.

At first it was a difficult matter to handle large numbers of telephone lines in a single exchange. The apparatus took up consider-

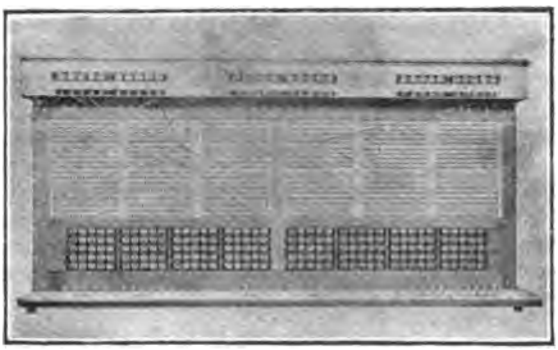
able space, and it was impracticable to bring the terminals of the various lines sufficiently close together that a connection between any two of them could be effected in a single operation. It therefore became necessary to employ more than one switchboard and more than one operator on each connection. A subscriber's call would be answered at one switchboard, and the call would be transferred to a second operator at a second switchboard where the line of the subscriber wanted was terminated. It was not uncommon in the early days of telephone exchange working to employ even a third operator, to nurse the connection, so to speak. It was difficult in those days to get people to talk together by telephone, and frequently they needed some encouragement from an operator at the exchange to induce them to engage in conversation.

The principle of the multiple switchboard, which is the fundamental principle of all large telephone switchboards to-day, was evolved as early as 1879, or within a year or so after the first practical telephone exchange was established; but multiple switchboards did not come into general use until several years later. The principle of the multiple switchboard is to repeat a spring jack or connecting point for every line before each operator in the exchange. An operator attends permanently to a certain number of lines, but, having before her a connecting point for every line served by the switchboard, she can

FIG. 22.

EARLY NEW YORK EXCHANGE.

FIG. 23.

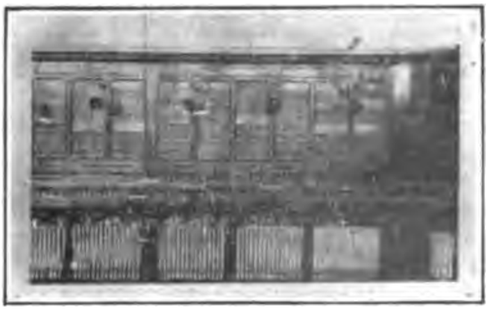


EARLY FORMS OF MULTIPLE SWITCHBOARD. NO ANSWERING JACKS.

complete a connection between the line of any of the group of subscribers directly served by her and the line of any other subscriber connected to the exchange in one operation. This method does away with the transfer of calls from one switchboard to another, and makes the work of establishing connections much simpler and quicker than it was with the original divided switchboards.

In a multiple switchboard each section is, as a rule, somewhat less than 6 feet long, and contains three operators' positions. In each section there is a connecting spring jack for every line in the exchange. Therefore, as regards the vertical part of the switchboard, each section is a duplicate or multiple of every other; hence the name of multiple

FIG. 24.



SERIES MULTIPLE SWITCHBOARD.

switchboard. In the earliest forms of multiple switchboard, only one set of jacks was provided at each section, but it was quickly found that it was a considerable strain on the operator to trace the relation between an indicator and any one of a thousand or more spring jacks. This arrangement was therefore modified by the introduction at each section of a certain number of special spring jacks, which form the terminals of the lines to be served at that section. These were called "answering jacks," as they were used exclusively for answering the calls of subscribers. There being at each section, or at each operator's position, a small group of signals and a small group of answering jacks, it was comparatively a simple matter for the operator to trace the relation, by means of the corresponding numbers, between any signal and any answering jack.

The horizontal portion of the switchboard, generally termed the key-board, serves as a support for the plugs and cords by means of which the operator effects temporary connection between the lines, and for the keys and switches by means of which the operator connects her own telephone set to the line of any subscriber as may be required, and connects the ringing machine to a line on which it is desired to signal for the attention of a subscriber. In modern types of switchboard some of the signals are also placed in the key-board.

At first the multiple switchboard was thought to be too complicated, and it was some little time before it was put into practical use on any scale. A very short experience, however, showed it to be so superior in ease of manipulation, in accuracy, and in speed, that within a very few years the multiple switchboard displaced all types of transfer and divided switchboards. Of late years there has been a tendency to return to a divided type of switchboard in which the calls of subscribers are answered at one switchboard and completed at another; but, as will be described later, these special switchboards are used to cope with special conditions which a close study of the telephone traffic of large cities reveals, or else are due to theories which do not always turn out well in practice.

In tracing the evolution of the multiple switchboard, we find that it has gone through numerous modifications, arising from improvements both in mechanical and electrical conditions. In the early days of the multiple switchboard a switchboard for a thousand lines was considered a large piece of work. For many years a switchboard for 5,000 lines was the largest in existence. At that time, owing to the size of the spring jacks and the relatively small number of lines which could be worked under the prevailing methods of operation at one section, such a switchboard consisted of some 44 sections. With improvements in manufacture, and with improvements in methods of signalling and methods of operating, it has become possible to work many more lines from one operator's position and to put many more spring jacks in one section. Consequently, switchboards for 10,000 lines are now made of practically the same length as a switchboard for 5,000 lines would have occupied a few years ago. It is practicable, indeed, to build multiple switchboards for even much larger numbers of lines than 10,000, and there are several multiple switchboards in existence or building designed to accommodate from 15,000 to 18,000 lines.

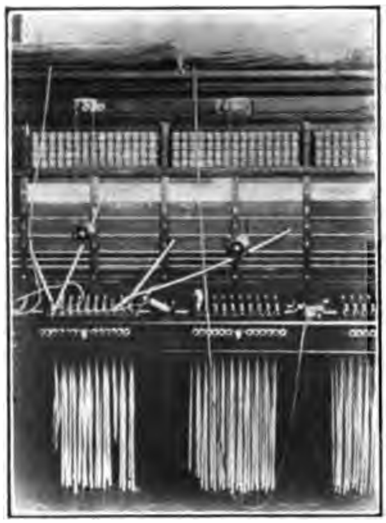
As described above, the separation of the two

springs of the spring jack when the plug was inserted, was utilised in the early switchboards for the temporary disconnection of the indicator from the line during the time that a subscriber's line was placed in connection with another. In the early telephone exchanges all the lines were single wire and the circuit through the switchboard was also a single wire circuit, the spring jacks being inserted in the line in series, the line going into one jack, so to speak, by one spring and coming out by the other, the pressure between the two springs maintaining a contact which was broken by the insertion of the plug. This gave a ready means of disconnecting the line signal whenever the line was in use, and of automatically restoring the signal to connection with the line when the plug was withdrawn. A few years' experience showed that it was necessary for good service to make all the lines of a city telephone system metallic circuit, as it was found that single wire circuits connected to earth picked up so many foreign currents by leakage and induction that communication was often impossible. Making the lines metallic circuit involved making the switchboard circuits also metallic. In the earliest metallic circuit switchboards the arrangement of the jacks in series was retained, but it was found that in large switchboards the series jack gave rise to many difficulties. With a large number of jacks in series on one line—and, as has been shown, there might be in a large switchboard as many as 45 jacks in each line—a sufficient number of bad contacts, due either to the presence of dust or to separation of the springs of the jacks, might arise to cause bad service. Also, in a large switchboard there would often be an unbalanced loop of wire running through the switchboard and back to the jack at which the connection was effected, which would be sufficient to throw the circuit out of balance and cause cross-talk or inductive action between one circuit and another.

In the single-wire switchboard the clearing-out indicator, which was temporarily associated with two lines in use by means of the connecting cord, was legged on to earth. In the metallic circuit switchboard it became necessary to bridge the clearing-out indicator between the two strands of the connecting cord, using an indicator coil of high resistance and impedance so as not to shunt the telephonic currents. The use of the clearing-out drop bridged across the line led naturally to the idea of bridging the line signal across the line and leaving it permanently connected to the line instead of temporarily disconnecting it every time a line was connected to another.

These inventions led to a greatly improved type of switchboard, in which much of the work was made automatic. This type of switchboard is generally known as the "bridging" or "branching" switchboard, and its outward distinction from the type of switchboard which preceded it arose from the fact that the various indicators were made

FIG. 25.



BRIDGING SWITCHBOARD WITH SELF-RESTORING DROPS.

self-restoring, thus saving the operator the work of restoring the indicator shutter every time that a signal was given by a subscriber. The self-restoring indicator marked a distinct advance in telephone switchboard operating, and the bridging method of connecting the indicators to the circuits marked a distinct advance in the electrical design of the telephone switchboard.

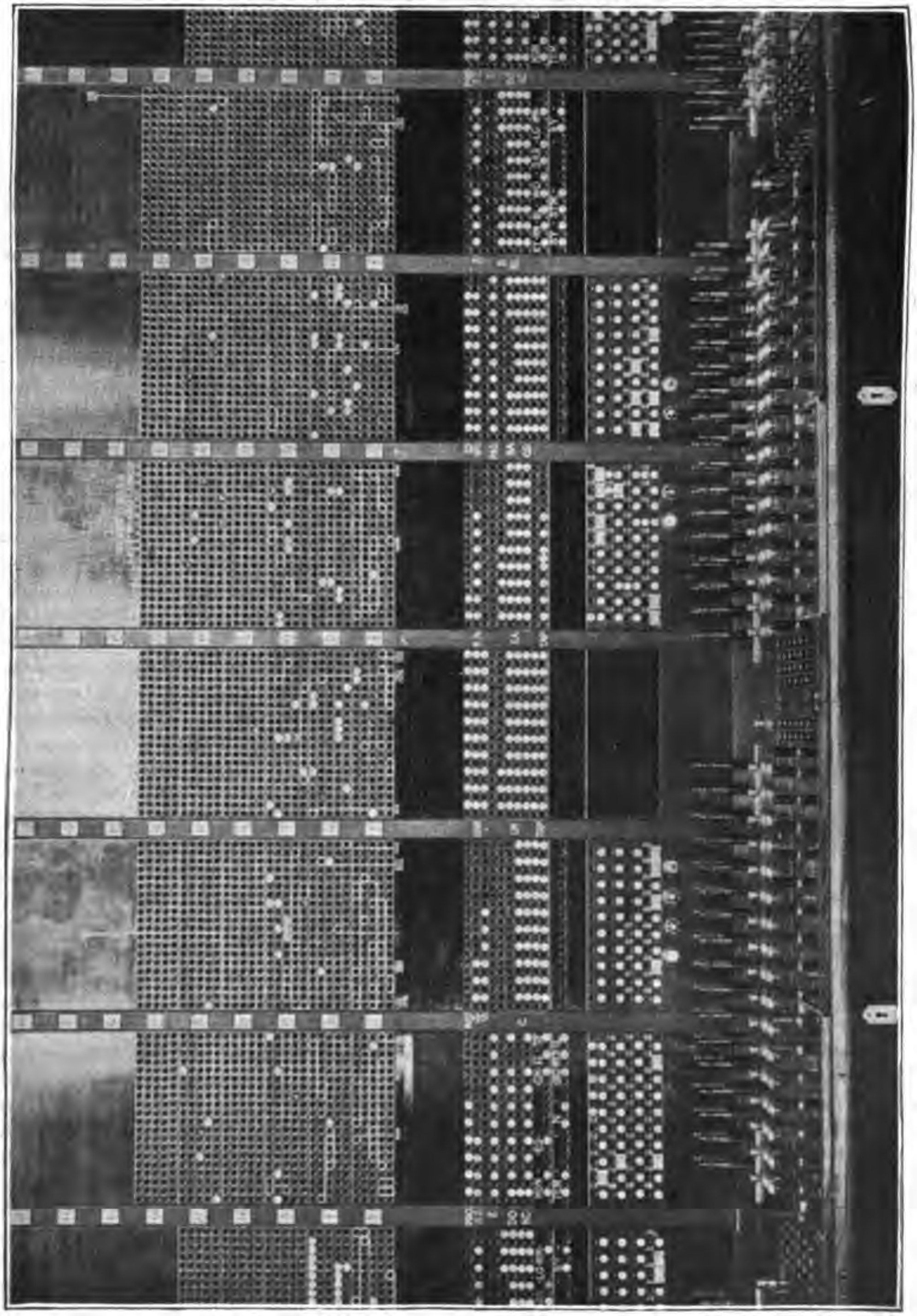
In the bridging switchboard the circuit throughout the board is a balanced metallic circuit, free from series contacts. Each line is joined to one spring of each spring jack, and different parts of the connecting plug, when inserted in the spring jack, make contact with each of these springs. The line signal is, as has already been said, bridged permanently across the line, and the indicator shutter is controlled by a restoring magnet inserted in a third wire which is local to the switchboard.

This wire is connected to a source of current and to contacts in the spring jack, so arranged that when the plug is inserted in answer to a call the circuit is completed and the restoring magnet energised, thus restoring the indicator shutter to its normal position. The clearing-out indicator is similarly made self-restoring, the restoring magnet in this case being operated by a depression of the listening key.

The self-restoring switchboard indicator, which was brought out in the early nineties, was largely copied by means of mechanically restored indicators, in which the indicator shutter was replaced to its normal position by the insertion of the plug in the spring jack or by the replacement of the plug on the cord shelf. It is of course easy to make either of these operations perform a second operation at the same time, by means of causing the plug to actuate a lever or cam on entering the jack or by causing it to trip a lever connected to a shutter when it drops back into its place on the cord shelf. These mechanical restoring devices, however, involve the close association of the indicator and the spring jack or of the indicator and the plug socket on the cord shelf, methods of construction which other requirements of a telephone switchboard make it not always advantageous to adopt. Consequently, these mechanically restoring devices are seldom used except on switchboards of small size.

We now come to the era of lamp signals and common battery working. From the very earliest days of telephone exchange working it has been the object of telephone engineers to do away with the use of individual batteries at the subscribers' stations. The cost of the upkeep of these batteries is very great, and their unequal performance renders it almost impossible, except at enormous expense, to maintain in a large system a high average efficiency of service. There have been many methods and devices tried with the object of working all the telephones of an exchange from one central battery, and there have been various methods tried, from the very earliest days of telephone exchange working, of making the signals required at the beginning and end of a conversation automatic, that is, making the natural acts of taking the telephone off the hook and replacing it control the necessary signals at the exchange. The storage battery at first displaced the collections of primary batteries originally used for energising the operators' transmitters at the exchange, and later was used at subscribers' stations instead of primary batteries, the storage batteries being kept constantly charged over the actual subscriber's line. In connection with this method of battery supply automatic signalling was adopted, first with electro-magnetic signals, and later with lamps controlled by relays. The gradual evolution of all these methods finally resulted in the complete common battery system, in which a storage battery at the exchange supplied the energy for all the telephones in the system as well as for operating all the various signals required in the switchboard. This system was worked out experimentally about 1894, and was then tried in small installations in America. With the experience gained in these trial installations improvements were made and the apparatus was sufficiently standardised to enable the system to be put into commercial operation about three years later. The great improvement which this method makes both in the economy and efficiency of telephone service has now made it the standard system of operating telephone exchanges, and practically no new work is now done on any other lines.

The first appearance of a power plant in a telephone exchange (Fig. 27, p. 1080) was in connection with the bridging switchboard just described. In the original switchboards there was placed a hand magneto generator at each operator's position, to enable the operators to ring the bells at subscribers' stations. These individual generators were very quickly replaced by a machine-driven generator, from which a supply circuit was carried along the switchboard and made available at each operator's position by means of ringing keys. This was the beginning of the telephone exchange power plant. To operate the signals and circuits of the bridging switchboard a more elaborate power plant was required, comprising storage cells with a generator to charge them, and about this time there was evolved the motor generator for supplying ringing current. In the common battery system the power plant reaches much larger proportions, as it is called upon to do a much greater variety of work than its predecessor. It replaces the batteries and magneto generators at all the telephones of the system, as current is taken from the one central plant to operate all the telephone transmittors in the system as well as all the signals in the switchboard. The source of current supply is a battery of eleven large storage cells which are charged periodically by a motor-driven



COMMON BATTERY SWITCHBOA

generator of 30 kilowatts capacity. The ringing machines, also motor driven, have been greatly improved and elaborated, and supply not only alternating current for ringing purposes, but also current of special characteristics for giving the distinctive signals required in the varied operations of a large telephone service. For example, an operator at a distant exchange informs the operator at an originating exchange that a line wanted in the distant exchange is "engaged" not by word of mouth, as was formerly the practice, but by means of an electrical signal which gives a distinctive hum or buz on the wire. In the same way other forms of current, giving distinctive pulsations or vibrations, are used for other special signals between operator and operator.

FIG. 27.

TERMINAL ROOM OF MODERN EXCHANGE, SHOWING POWER PLANT.

In the common battery switchboard, practically all of the signals employed are lamps, instead of indicators, and this gives the face of the switchboard an entirely different appearance from that of a switchboard of the older type, in which indicators were used as signals. The lamp has so many advantages over the electro-magnetic indicator as a telephone switchboard signal that, although the early lamps and the relays for controlling them gave rise to much trouble, continuous efforts were made to reduce them to a practical and reliable state, with such success that within a very few years thoroughly efficient telephone relays and lamps were produced. This says a good deal for the telephone manufacturers, as the telephone lamp is necessarily extremely small, and works under much more difficult conditions than the ordinary electric lamp, while the telephone relay to be really useful must work with certainty, often on a comparatively small margin of current, and often a very large number of times each day. That the difficulties in the production of reliable lamp signals and relays have been completely overcome is clear from the fact that telephone lamps and relays are now in use by the million, and that the telephone service of practically every city in America, and of many large cities in Europe, is conducted entirely by means of relays and lamps.

The lamp signal is not only more effective as a signal than the indicator, but it has the great advantage of being automatic or self-effacing. It is also extremely compact, and as it has no working parts it may be placed in any position on the switchboard, vertically, horizontally, or at an angle; an indicator could naturally be placed only in one position. As a result of these qualities of the lamp signal, we see that it has been possible to effect many improvements in the telephone switchboard, which make greatly for its efficiency and economy. In the original series switchboard it was necessary to place the signals within reach of the operator, as the operator had to restore the indicator shutters by hand. In large switchboards this involved the use of a trough behind the keyboard (in which the indicators were placed), to permit the top rows of the multiple jacks to be within the reach of the operators. In the bridging switchboard, as the indicators were self-restoring, they were placed at the top of the switchboard, thus effecting a considerable gain in space in the face of the switchboard available for multiple jacks. But in both these arrangements it was necessary for the operator to trace the relation between any given indicator and its corresponding spring jack or cord, and this involved a certain mental effort. The compactness and simplicity of the lamp signal enabled it to be placed immediately adjacent to the particular spring jack or cord to which it is related. Thus, in the common battery switchboard we find each signal immediately above or below its corresponding answering jack, and each cord signal immediately alongside its corresponding cord. This arrangement makes greatly not only for the compactness of the switchboard but for accuracy in operating, as there is never any doubt as to the meaning of a signal or the particular part of the switchboard which has to be manipulated in response

to a signal. The work of the operator is therefore greatly simplified and becomes correspondingly more rapid and more accurate.

In the operation of the common battery switchboard it will be seen that the working has become more automatic than in the form which immediately preceded it. A very great improvement has also been introduced in the provision of automatic means for supervising the state of two subscribers' lines when connected for conversation. In the older system the clearing out signal was dependent on the memory of the subscriber; the subscriber had to turn his generator to actuate the signal and it has been the invariable experience of telephone managers that many subscribers habitually forget or neglect to perform this operation. This would naturally result in many connections being left up longer than is necessary, as the operator, not receiving a signal to disconnect, would only after a time discover that the subscribers had finished talking and had failed to give the signal. In the common battery system this state of affairs is done away with altogether, as there is a lamp signal on each of the cords used to connect subscribers' lines, and the operation of each signal is governed by the condition of the corresponding subscriber's telephone. If the telephone is on the rest the cord signal lamp —or supervisory lamp, as it is termed—is alight, and if the telephone is off the rest the supervisory signal is extinguished. The presence of these two signals enables the operator to see at a glance the state of any connection which is up at her position. When she connects a subscriber wanted in response to another subscriber's call, the supervisory lamp on the connecting cord lights as soon as she inserts the plug in the multiple jack and remains alight until the called subscriber answers. When the called subscriber takes his telephone off the hook the supervisory lamp goes out, and this notifies the operator that the called subscriber has answered. From that point the supervisory lamps will continue to keep the operator informed of the state of the connection. If one subscriber hangs up, the corresponding lamp lights, but the other lamp, remaining extinguished, indicates to the operator that the corresponding subscriber is "holding the line." When both subscribers hang up, both supervisory lamps light, and this is a positive indication to the operator that the two subscribers have finished conversation and wish the lines to be disconnected. The operator then immediately takes down the connection without listening in. This automatic supervision and positive disconnection signal are very valuable qualities in the common battery method of working. Under the older method a large amount of the operator's time was devoted to supervising each connection in order to ascertain whether the two subscribers got together satisfactorily, and whether they had finished conversation and neglected to give the disconnection signal. All that work is now done away with, and the operator, can follow the movements of the subscribers by means of the two lamps practically as effectively as if she were watching the motions of the actual persons using the two distant telephones. Apart from the increased efficiency which this method gives to the operator, it also largely increases the efficiency of the service by reducing the amount of time during which the subscribers' lines are connected together uselessly, thus reducing the "engaged" trouble, which is one of the principal difficulties and sources of friction in all large city telephone systems.

As a result of these various improvements it may be said that the telephone switchboard of to-day is at least twice as efficient and economical as the telephone switchboard of ten years ago. It gives a far more regular, accurate and speedy service to the subscribers, and it performs its work with much less strain on the operators. The apparatus required to effect these results is, of course, complicated and extensive. Every line signal, for example, is controlled by two relays, one which causes the lamp to light when the subscriber takes his telephone off the hook, and one, termed the cut-off relay, which automatically extinguishes the lamp when the operator plugs into the answering jack. Also, as touched on above, the power plant of the modern telephone exchange is quite an important installation, but it must be remembered that these appliances, all concentrated in one department under expert supervision, take the place of thousands of individual appliances which were formerly scattered among the individual subscribers' stations. The relays and power plant of the exchange take the place of the myriads of generators and primary batteries formerly used at the outer ends of the lines. Therefore the subscriber's instrument, the appliance which is in the hands of the public, and repeated in tens of thousands of different premises, has become extremely simplified, and consists now only of transmitter, receiver, bell, and the neces-

sary switch-hook to change the circuit from the bell to the telephone; and this great gain of simplicity in the instrument which has to be repeated many thousands of times more than compensates for the additional complication of apparatus at the exchange end.

TELEPHONE BUILDINGS.

A very important part of the modern city telephone plant is the central office building. It is necessary that a telephone exchange building should be of special construction, both because of the necessity for the utmost precaution to prevent fire and because of the very special nature of the plant to be contained by the building and of the accommodation to be provided. The telephone exchange building, to begin with, has to serve as an anchorage or point of concentration for the underground cable plant, and its site has to be chosen not with regard to the most convenient or most economical position as dictated by property considerations, but with regard to the most convenient and economical position as dictated by telephone conditions; that is, the building should be placed at the economical telephone centre of the area to be served, and this fact often necessitates the construction of a building of an entirely different character from the neighbouring buildings in the same locality. For these reasons it is necessary to consider the telephone building as a part of the plant, and in the long run satisfactory results will not be obtained unless this is recognised and special telephone buildings, designed exclusively for the accommodation of telephone plant, are made an integral part of city telephone systems.

The accommodation which a telephone building has to provide may be divided into three general parts—the terminal room, providing for the termination of the underground cables and their junction to the switchboard wires and the power plant; the operating room, providing for the accommodation of the switchboards; and the operators' quarters, consisting of cloak-rooms, dining-rooms, reading-room, etc. In the older buildings it was the practice to terminate the underground cables in air-tight cable heads supported on racks placed in the basement or cellar and to effect the junction with the switchboard wires by means of house cables extended from the cable heads to the distributing frame. The modern practice is to abolish the cable head and by means of what is known as a "pot-head joint" to extend the underground cable conductors direct to the distributing frame. The distributing frame is a flexible link joining the outside wires to the switchboard wires. Owing to the numerous changes which constantly occur in the distribution of the various wires in a telephone system it is necessary to have a ready means of changing the relations between the switchboard wires and the outside wires. This is afforded by the main distributing frame, a long rack or framework on which are terminated in regular order on one side all the conductors of the cable plant, and in regular order on the other side all the wires of the switchboard plant. By means of pairs of wires termed "cross connecting" or "jumper" wires, which are passed through the centre of the rack, any pair of outside conductors may be joined to any pair of switchboard conductors as desired.

A second frame-work of the same kind is termed the "intermediate distributing frame,"

FIG. 28.

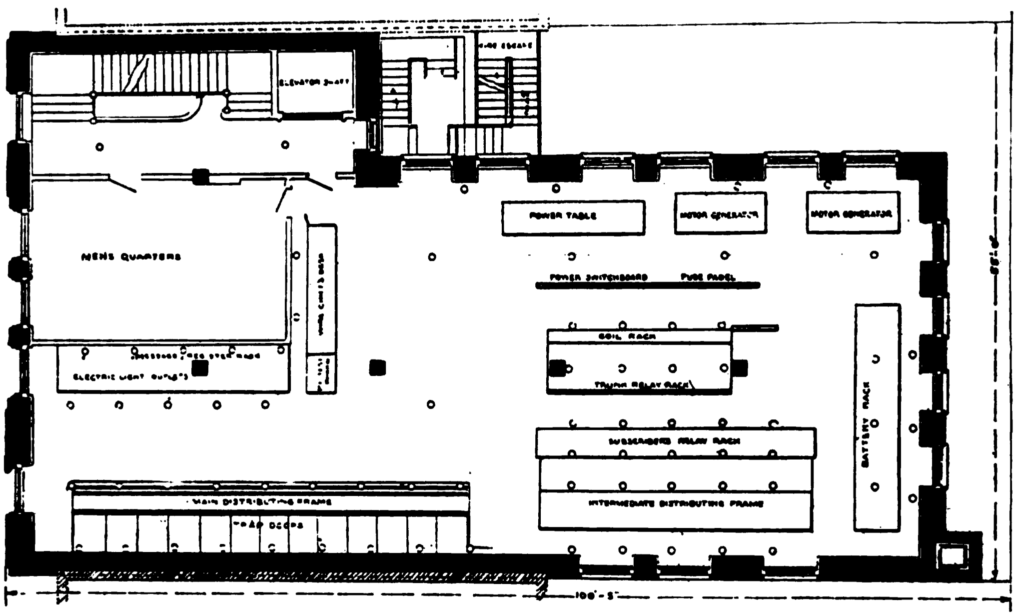
TERMINAL ROOM OF MODERN EXCHANGE, SHOWING RELAY RACKS, DISTRIBUTING FRAMES, AND TESTING OUTFIT.

and this affords a means for varying the distribution of the line signals and answering jacks in the switchboard. It frequently becomes necessary, in order to equalise the load at the various operators' positions in the switchboard, to vary the number of lines terminating at different positions. The intermediate distributing frame forms a flexible link between the answering jacks and line signals and the multiple circuits which run through the switchboard. By varying the connections at the intermediate distributing

frame the actual terminal of a subscriber's line can be removed from one part of the switchboard to another.

These two distributing frames, together with the relay racks carrying the various line and cut-off relays, and the whole of the power plant, consisting of duplicate sets of charging generators and ringing machines, are now generally placed all in one department, and usually occupy the whole of one floor. A floor of similar dimensions is occupied by the cloak rooms, dining-room, and resting rooms for the operators, and the top floor,

FIG. 29.

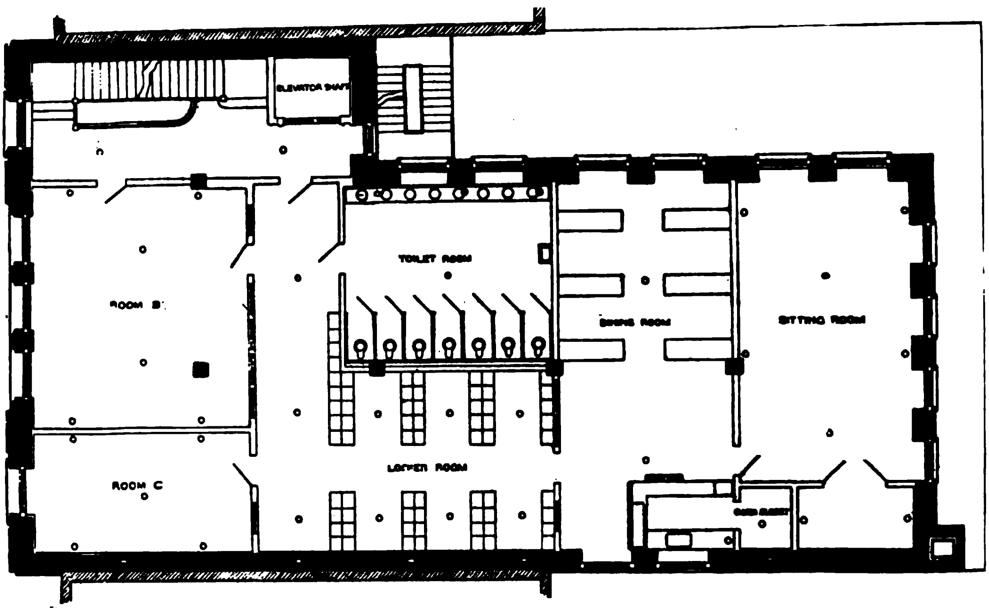


MODERN TELEPHONE BUILDING. Floor Plan of Terminal Room.

where the condition of light and air are the best, serves as the operating room. The ideal conditions required for the telephone operating room are good light and ventilation and free floor space of such dimensions that the switchboard may be carried in a continuous line so as to avoid sharp angles or end sections, which are uneconomical for the reason that they occupy switchboard space without giving corresponding working positions. The floor plans of a modern telephone exchange building in New York (Figs. 29, 30, 31) illustrate the arrangement of a typical city telephone building.

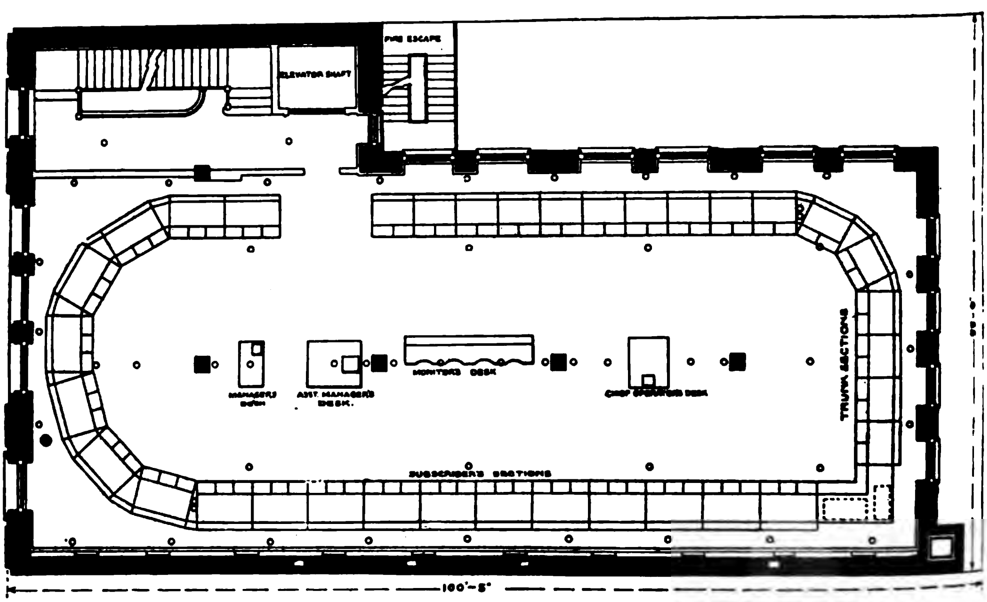
While, as pointed out above, the great improvements made of recent years in all parts of the telephone switchboard enable many more lines to be worked from one exchange than was practicable ten years ago, the best experience shows that it is not advisable to build in large cities exchanges of more than 10,000 lines capacity. This is not universally admitted, however, and there have been several schemes devised to permit of much larger numbers of lines being worked from one exchange. The capacity of the standard multiple switchboard is about 15,000 lines—that is to say, with switchboards arranged with the answering jacks in the multiple sections there is space for about 15,000 multiple jacks in a section of such a size that all parts of it are within reasonably convenient reach of the operators. If the answering jacks and line signals be placed somewhere else than at the multiple sections, space is freed for further multiple jacks, and the capacity of the switchboard can be increased. If the switchboard be divided into several parts, and the subscriber be provided with means for selectively signalling the several different parts, according to the number with which he wishes to be connected, there is practically no limit to the number of lines which may be connected to one exchange. Both these methods of increasing the capacity of a single exchange are in actual use. In the new exchanges

FIG. 30.



MODERN TELEPHONE BUILDING. Floor Plan of Operators' Quarter.

FIG. 31.



MODERN TELEPHONE BUILDING. Floor Plan of Operating Room.

built at Moscow and Warsaw by L. M. Ericsson and Co., of Stockholm, the line signals and answering jacks are all at special answering switchboards, and the multiple switchboard is devoted to multiple jacks exclusively. By the use of a very small multiple jack, and by having the whole vertical face of the board available for multiple jacks, it is expected to obtain an ultimate capacity of some 30,000 lines in the one switchboard. In the method of operating, the operator at the answering board, on receiving a call from a subscriber, plugs the calling line through to an operator at the multiple board. This second operator then answers the call and completes it in the usual way. The connecting lines between the two switchboards are equipped with lamp signals which automatically indicate to the answering operators which of the connecting operators are free to receive a call, and to the connecting operators the particular cord and plug to which a call has been transferred by one of the answering operators. The answering operators do no talking at all, but simply plug the lines of calling subscribers through to operators at the multiple board who are free to handle the calls. When a connection is taken down at the multiple board a lamp signal on the connecting cord at the answering board automatically signals the fact to the answering operator, who in turn completes the disconnection of the line indicated. A similar system of working is in use at the Stockholm Exchange of the Swedish State telephone system.

The other system referred to of increasing the capacity of an exchange above the limits of a standard multiple switchboard is what is what is known as the "divided multiple." This was introduced in America some ten years ago, and although it is disappearing from American practice, this method has been adopted in the new municipal exchange at St. Petersburg. The principle is to divide the switchboard into several portions, each portion containing multiple jacks for a certain number of subscribers. For example, board No. 1 would contain lines for subscribers from No. 1 to No. 20,000. Board No. 2 would contain lines for subscribers from No. 20,001 to 40,000, and so on. Each subscriber is provided with a line signal and an answering jack at each of the divisions of the switchboard, and it devolves upon the calling subscriber to actuate the particular line signal in the division of the board which serves the multiple line of the subscriber to whom he wishes to be connected. One of the radical defects of this system is that it robs the subscriber's instrument of its simplicity. The subscriber's instrument must be provided with two or more buttons in order that the subscriber may signal the particular division of the switchboard which can handle his connection. This provision of several different signalling buttons to be operated at the will of the user of the telephone gives the means of making erroneous calls, and it is common experience that when means for committing errors are put in the hands of the public many errors are committed. The preponderance of telephone experience regards unfavourably any system which puts into the hands of the general public an instrument requiring specific manœuvres for the proper working of the service.

Automatic Exchanges.

There have been devised numerous methods whereby telephone lines may be switched together by means of electro-mechanical apparatus operated from the subscribers' telephones. The general principle of these systems is a selective switch controlled by a selector or impulse transmitter attached to the subscriber's instrument. The broad result is that the operation of the service is transferred from the operator to the subscriber, and to effect this result there is brought into use apparatus of considerable complication at both ends of the system.

That the so-called automatic exchange will ever entirely displace the so-called manual exchange appears very unlikely. There are several automatic exchanges in practical and successful operation, but in all cases these automatic exchanges are second or additional telephone systems in the towns in which they operate, and they do not by any means carry the whole telephone traffic of the area which they serve. In the telephone service of any large city or group of towns the possible range of selection of telephone calls is so great that it seems impracticable for any purely mechanical system to cope with it.

Thus, in the automatic systems the human operator quickly appears to handle suburban and long distance calls. It is also necessary to have an operator to handle inquiry calls, and for these various reasons the mechanical system soon ceases to be purely mechanical. It is hardly realised by those who term the mechanical switch systems automatic, how largely automatic the standard common

battery system really is, but a detailed inspection of the working of the standard common battery system shows that with the exception of the actual selection of the numbers and insertion and withdrawal of the connecting plugs almost all the operations are automatic.

The subscriber automatically signals the exchange by lifting off and replacing the telephone and the signals thus automatically set are automatically re-set by the insertion and withdrawal of the plugs at the exchange. The signals on the junction lines connecting one exchange with another are similarly automatically set and re-set, and the ringing is done automatically after a single depression of a button. Human labour and human intelligence are employed in that part of the work where, under the existing conditions, it would seem that they can best be employed, namely in the prompt selection of individual numbers from the immense range of numbers which exist in the modern city telephone system. It seems likely that in the future development of the telephone system the operator will never entirely be done away with in favour of the machine, but that the machine—*i.e.*, the automatic device, of whatever character it may be—will be more and more extensively employed, but always rather under the control of the expert operator than of the inexpert member of the public.

AUSTRALIAN MANUFACTURES.*

Although in the infancy of its national existence, and having to struggle with the disadvantage of possessing only a limited population in a territory capable of supporting as many millions as are to be found in Continental Europe, and yet have plenty of country to spare, the Commonwealth can boast that in addition to its remarkable pastoral, agricultural, and mining development, it is furnishing a large and remunerative field for manufacturing enterprise. Already, according to official statistics, the amount of capital employed in Australian manufacturing industries is estimated at something like £60,400,124; of which £19,484,122 represents the value of land, buildings, &c.; £20,357,002, machinery and plant; and £20,559,000, cash and sundries. The figures at the close of the present year will show a considerable advance upon those quoted. The various industries cover a wide field, and include those treating raw pastoral and agricultural materials; animal, vegetable, and other oils and fats; processes in stone, clay, glass, &c.; working in wood, metal-works, machinery, &c.; connected with food, drink, &c.; clothing and textile fabrics and materials; books, paper, printing, engraving, &c.; musical instruments, arms and explosives; vehicles and fittings; harness, saddlery, &c.; ship and boat-building, &c.; furniture, bedding, and upholstery; drugs, chemicals, and by-products; surgical and other scientific instruments; jewellery, time-pieces, and plated ware; heat, light, and power; leather ware; and others of a miscellaneous character. The number of people, male and female, employed on the various industries is estimated at 196,424; of whom 86,284 are engaged in producing commodities coming into competition with imported goods. The difference between the value of the materials, fuel, &c., employed, and the total value of the output represents the real value of manufacturing production. At the close of 1903 the figures were £28,528,000; a large amount considering that the bulk of the production was intended for local consumption amongst a limited population. The average weekly rates of wages for men in New South Wales ranged from £2 8s. 8d. to £1 0s. 10d., and in Victoria from £2 4s. 11d. to £1 1s. 11d. As a large number of lads are employed, the wages of the men are considerably higher, but it is difficult to eliminate the juvenile element from the calculation. Taking several of the leading industries, it is found that 1,592 hands are engaged in the manufacture of soap and candles; 7,859 in the production of bricks, tiles, pottery, earthen and glassware, &c.; 36,376 in the manufacture of agricultural implements, brass and copper goods, cutlery, galvanised iron, engineering and ironworks, foundries, lead mills, smelting works, railway and tramway workshops, tinsmithing, wire-working, and other metal works; 12,564 in boot and shoe making; 31,691 in the manufacture of male and female articles of clothing; and 5,440 in the production of furniture, bedding, &c. Numerous other manufacturing industries might be enumerated, but the foregoing will suffice to indicate their general character. There are nearly 12,000 industrial establishments of all kinds, employing close upon 200,000 hands, with a steadily increasing tendency in the number of both. Generally speaking, the character of the locally-made commodities is fully equal to that of the imported goods with which they come into competition, the great disadvantage under which Australian manufacturers labour consisting in the fact that the average rates of wages are higher and the hours of labour fewer than in oversea countries. In Victoria the system of sweating is prohibited by law, and in New South Wales it is checked by the operation of the State Industrial Arbitration Act. In articles demanding the employment of artistic taste there has been a rapid advance, a result of the increasing spread of technical education, many of the workmen students in the technical colleges producing specimens of their handicraft fully equal in beauty of design and delicacy of execution to anything of the kind met with in Europe and America.

* Communicated by Mr. John Plummer, of Sydney.

THE EXPORT TRADE OF THE UNITED STATES.

Exports of manufactures from the United States in the fiscal year ended June 30, 1905, were not only the largest on record, but are in excess of the combined exports of all articles in the centennial year 1876, and nearly twenty-eight millions sterling more than the total imports and exports of the country at the end of the Civil War. Figures just compiled by the United States Bureau of Statistics show that the exports of manufactures in the year just ended amounted to £113,254,000, as against £94,253,000 in the preceding year, £90,386,000 in 1900, and £38,249,000 in 1895. The growth in exports of manufactures far exceed the growth of population, or the growth in commerce as a whole. This is apparent from an examination of the following Table, showing the population, commerce, and exports of manufactures of the United States in 1800, 1876, and 1905, and the percentage of increase in each since 1800 and 1876, the beginning of the greatest era in American development :—

Years.	Population.	Commerce (Imports and Exports of Merchandise).	Exports of Domestic Manufactures.
		£	£
1800	5,308,483	31,746,000	510,000
1876	45,137,000	208,567,000	20,935,000
1905	83,145,000	547,182,000	113,254,000
Per cent. of Increase.			
1800-1876	750	517	3·930
1876-1905	81	63	441

An examination of the statistics of exports of domestic manufactures, especially in recent years, by articles and countries of destination, shows that about 30 manufactured articles were exported during 1905, with value in excess of £208,000 each, and that of these articles, all except seven showed an increase as compared with exports of 1904. Iron and steel manufactures supply about one-fourth of the manufactured articles exported from the United States, the total in 1905 having been £28,068,000, as against £23,322,000, in the preceding year, an increase of nearly five millions sterling. Steel rails showed an increase of £1,250,000, chiefly in shipments to Canada, South America, Mexico, the West Indies, Japan, and the eastern countries, in several of which, railway development is proceeding at a rapid rate. Machinery also showed an increase in 1905 of more than £1,250 000 over 1904. A conspicuous feature, however, is the large increase in exports of locomotives to Japan, 151 engines having been sent thither in 1905 as against 74 in the previous year. Mexico and Argentina increased their purchases of American sewing machines, while Japan increased her purchases of electrical machinery and builders' hardware, each in a substantial degree. Copper manufactures, consisting largely of pigs and bars, form the item of second importance in the United States exports of manufactures, the total being £17,963,000 in 1905, as compared with £11,905,000 in the preceding year. This growth of six millions sterling in a single year is accounted for by an increase in exports to China, the United Kingdom, France, Germany, the Netherlands, and Russia. Refined mineral oil ranks third in the exports of manufactures, the total being £14,996,000, against £14,948,000 in the preceding year. Owing to the fall in prices the value remained practically stationary, despite the fact that the quantity increased from 847 million gallons in 1904 to 951 millions in 1905. The countries to which the largest exportations were made were—the United Kingdon 221 million gallons, Germany 342 millions, Netherlands 117 millions, China 90 millions, Belgium 46 millions, British East Indies and Japan each about 30 millions, Italy nearly 29 millions, and France 27 millions. Cotton manufactures present one of the striking features of the year's export trade, having advanced from £4,650,000 in 1904 to £10,347,000 in the year just ended. To China there was an increase of about 400 million yards over last year's exportation, and the value of American cotton cloth exported to that country increased from £830,000 in 1904 to £5,780,000 in 1905. Leather and its manufactures, fourth in importance in the list of manufactured articles exported, showed an increase of £830,000, the total in 1905 having been £7,916,000, as compared with £7,020,000 in the preceding year. In this class of goods Japan is credited with the chief increase. Other important articles exported from the United States in the year ended 30th June, 1905, were agricultural implements, chemicals, dyes, drugs, &c., wood manufactures, cars, carriages and vehicles, paper and manufactures thereof, and india-rubber manufactures. The following Table shows the exports of the manufactures of the United States, and the total exports from that country, decennially from 1870 to 1900, and especially from that year up to the present time :—

Years (ended 30th June).	Exports of United States Manufactures.	Total Exports of Merchandise
	£	£
1870	14,225,000	81,828,000
1880	21,428,000	174,091,000
1890	31,479,000	178,714,000
1900	90,386,000	290,517,000
1901	85,611,000	309,951,000
1902	84,092,000	287,888,000
1903	86,901,000	295,862,000
1904	94,253,000	304,339,000
1905	113,254,000	316,367,000

HOME INDUSTRIES.

The Neglect of Forestry.—In discussing the Cottage Exhibition at Letchworth it has been said that wooden structures have much to recommend them, and that it is regrettable that more wooden cottages are not built in the rural districts. But it may be doubted whether under present circumstances wood would often prove much cheaper than brick. The wood would have to be of mature growth, and free from sap, and that is expensive whether got from abroad or at home. As to home-grown timber it is quite as costly as foreign, and much less suitable, being reared so badly that boards and scantlings cut from it are more often than not full of knots, shakes, and twists. And they in turn are the result of the general ignorance of forestry. In 1888-89 a Select Committee sat to inquire into the condition of forestry in Great Britain, the possibility of improvement, and the necessity for the provision of better means of education. Various recommendations were made but nothing came of them, and when the Committee of 1902 was appointed it started very much at the same point as did the earlier Committee. It is true that now forestry is one of the subjects of which the Board of Agriculture has charge, and that department is doing good work in relation to it, but the management of existing forests still leaves much to be desired, and little is being done to extend the forest area.

The Financial Aspect of Afforestation.—There is in these islands a very large area of waste, heather, and rough pasture, or land out of cultivation, on which afforestation might be profitably undertaken. It has been said that our soil and climate are unsuited to the growing of woods, but this opinion may well be traversed, nor is it that of foreign experts. In their opinion our soil and climate are very favourable, and the magnificent isolated trees to be seen in parks and on road sides proves this. The suggestion that we have too little sunshine will not bear examination. We have at least as much as Norway, Sweden, Finland, and the southern and eastern shores of the Baltic, whence much of our imported timber comes. As to the financial aspect, the available data with regard to returns suffer under two great drawbacks. First, the greater part of the areas under forest in this country do not produce as much timber as they would if properly managed, and secondly, the returns available are mostly a little haphazard. But it may safely be said that, placed suitably, properly managed woodland pays. Mr. Arthur Vernon, whose experience of estates in which there is considerable woodlands is very great, told the Committee of 1902 that the best woods can be made to return £2 an acre for a long succession of years, and he instanced Hughenden, of which he is the agent. The woods on the property are small, covering about 200 acres only, but they have produced an average of £2 per acre per annum for a great number of years. Deduct 15 per cent. as the cost of felling and selling the timber, the cost of the woodmen, and other expenses, and the net return works out at about 27s. an acre. It may be said that this large profit is due to High Wycombe being the centre of the chair trade. No doubt it has much to do with it. The nearness of the raw article created the trade and the demand, and easy means of supplying it enhances the profit. But what they have done at Hughenden might be done in many other parts of the country. There was bad land on the estate, cold, hilly, and exposed. For agricultural purposes it was not worth more than 10s. an acre. The owner put it into wood, and nearly trebled its value, besides creating a home industry, giving work to many. Granted that the woodland profit in the Chiltern districts is exceptional there is plenty of poor grazing land suitable for afforestation. Much of it would be more profitable in growing timber than in agriculture. A good deal of it is grazing pasture let at 9d. to 1s. 6d. an acre, and even under the worst conditions of forestry something more could be got out of it than that.

The Area Suitable to Afforestation.—What may be called the waste land in the United Kingdom is very large. Its area (excluding mountain and heath) in England is given in the agricultural returns at 5,396,250 acres, in Wales at 669,609 acres, in Scotland at 5,028,833 acres, or a total for Great Britain of 11,694,792 acres. Then there are 12,788,165 acres of mountain and heath land used for grazing, or altogether 24,482,957 acres. There are of course difficulties in the way of making land available, even land that is now used for so-called light grazing, but these difficulties ought not to be insurmountable. It is impossible to say what portion of this waste and heather is available for proper afforestation but it must be considerable. It would not be easy to deal with the rights of grazing, and in some districts they would prevent afforestation, but in many cases the difficulties might be overcome.

The Preference for Foreign Timber.—However regrettable, the preference for foreign timber is easily understood. It is not to be attributed to unsuitability of soil or climate, but is entirely due to neglect of agricultural principles. Timber of the kind and quality imported in such large quantities from the Baltic, and elsewhere, can be grown as well here as anywhere, in fact, Continental "red wood" and "white wood," so highly esteemed for structural purposes, are yielded by the Scots pine and the spruce, two of the commonest trees of British woodlands. But until recent years, owners of woodlands failed to realise that the shape, size, and quality of trees could be influenced by anything they could do. They seemed to imagine that the character of the final product was largely a matter of accident, whereas it is mainly determined by management. They failed to realise that cultural treatment which suits oak or ash, is unsuited to pine or spruce, and this explains why British coniferous timber has been generally excluded

from building specifications. Indeed few landowners took any personal interest in their plantations. Here and there more enlightened management might be found, as on the Duke of Bedford's estates, but the exceptions were few. For, speaking generally, the landowner does not make up for his own indifference by employing competent, and therefore well paid foresters, as in Germany. There are still estates in Scotland with 20,000 acres of wood without an efficient forester, managed by men getting 30s., or even less, a week.

Afforestation and Labour.—It may be urged that it is not desirable to turn cultivatable land into woodlands, since labour would be displaced, but in fact land under forests would give healthy employment to a much greater number of persons than the same area under sheep. "Many hill pastoral farms," the Committee say, in their report, "have one shepherd to three or four thousand acres, but much of such land, for various reasons, is unsuited to the growth of timber for profit. We believe that we are within the mark in assuming that land capable of producing high-class timber employs only one shepherd per 1,000 acres if used as a sheep run, while all the evidence on this point goes to show that similar land when under timber gives employment to at least one man per 100 acres, and this without taking account of the labour requisite to remove and work up the timber." The Committee pointed out the importance of afforestation in such a district as the Highlands of Scotland. Rough land is extensive, capital as a rule scarce, and great woodland areas, where well managed, have proved financially successful, while profits on sheep farming have of late years reached a very low point. Almost nine-tenths in value, and over nine-tenths in quantity of our present imports of wood consist of pine and fir timber capable of being grown at home, and nearly three-fourths of this coniferous wood in quantity, and more than four-fifths in value, are imported as sawn or split. If we could grow our own supplies of wood, large sums now spent abroad would be distributed among the industrial classes at home in addition to the large labour bills that would be payable in the woodlands themselves.

The World's Supply of Timber.—Unless the Canadian forests are treated more scientifically—very large tracts have already been destroyed by indiscriminate clearance, forest fires, and otherwise—it is not unlikely that there will be a shortage of timber before long. The only sources of a large supply of conifers are the countries round the Baltic and North America. A little comes from Australia—£163,411 worth of wood and timber in 1904—a little less from the Gold Coast, and small quantities from other colonies. There are extensive forests in the back part of the Argentine Republic, but at present the difficulty of getting out the timber is very great. There are believed to be great forests in the western part of China round about the broad waters of the big rivers, but as soon as the trade and industries of China have developed—and they are developing rapidly—the home market will want it all, and more. So that for the most part we have to rely upon the Baltic and North America. As to Russia, only about 25 per cent. of the country has more forests than are required for home consumption—the quantity of timber required for local needs where, as in Siberia, most of the houses are built of wood and burnt down once in every twenty years or so, where the long winters demand an immense consumption of fuel, and the railway, steamers, and all the new industries depend largely on wood both for construction and for fuel, is necessarily very great. The supply from Sweden and Norway is much less than it was, and although there is an immense area of forest land in Canada, of which more than a fourth may be classed as timber forests, the exports to the United Kingdom do not increase. Indeed the value of all kinds of timber received by Great Britain from Canada in 1904 was only £12,618,267, as compared with £13,878,839 in 1903. The supply of hard woods is ample, reference here is limited to coniferous timber.

The Obstacles to Afforestation.—Much as the extension of afforestation is to be desired on national grounds, it is to be feared that landowners will not extend the forest area to any great extent unless they are encouraged to do so by some alteration in their favour in the incidence of rates on plantations. Rates and taxes together sometimes amount to 7s. or 8s. an acre, and it has been suggested that landowners who are prepared to lay out some money on plantations should be relieved of rates altogether for a period until some income is derived from the woodlands. The Forestry Committee did not see their way to make this recommendation, nor were they willing to recommend that the State should advance loans to encourage afforestation. The many years the landowner has to wait for a first return is perhaps the chief obstacle to afforestation. He does not care to submit to a present sacrifice in order to secure an ultimate return that may benefit his successor rather than himself. Eight shillings per acre per annum for rates and taxes, plus the cost of looking after the plantations, with absolutely nothing coming in, does not commend itself to men many of whom, with falling rents and fixed charges, find it difficult to pay their way. And it must be borne in mind that planting is very expensive work. The cost of making plantations is far greater than it used to be. From 30s. to £2 an acre it has grown to from £6 to £8; the cost of plants and labour is twice as great as formerly, and the swarms of rabbits necessitates wire netting costing from 50s. to £3 per acre planted. Moreover, many landowners under-rate the value of woodlands, and what they can be made in time to return under scientific management. Here the State might do

much by the provision of adequate facilities for instruction in afforestation. And it is satisfactory to know that some steps are being taken in this direction. But a large area of woodland for purposes of practical demonstration is a necessity.

OBITUARY.

CHARLES WENTWORTH WASS.—By the death of Mr. C. Wentworth Wass, the Society loses one of its very oldest members, his election dating as far back as 1849. Mr. Wass was born in London, 1817, and was intended for the Church. But at the age of 16 he was apprenticed to the engraver, Richard Woodman, and during the period of his apprenticeship, in 1835, he obtained the Silver Isis Medal of the Society for a copy in chalk of a historical subject. At the end of his apprenticeship, he took chambers in the Adelphi, and started as an engraver. Amongst the works produced by him were engravings of works by Etty, Landseer, Ansdell, Poole, Bateman, Herring, and Sant. Much of his work was produced by a combination of etching, mezzotint, stipple, and line, and he was one of the most successful workers by these mixed methods. When the Crystal Palace Picture Gallery was established, Mr. Wass was appointed its superintendent, a post which he held until about five years ago when the directors of the Palace decided to give up the Gallery. Mr. Wass was considered an excellent judge of pictures and of china, and during his long life he accumulated a collection of works of art, believed to be of considerable value.

GENERAL NOTES.

EDUCATION OF APPRENTICES.—The Board of Education have issued a memorandum on the subject of co-operation between employers of labour and school managers with regard to the instruction of *employés* or apprentices. The Board desire to secure the assistance and co-operation of employers in encouraging the education of their apprentices, and they take note of several ways in which such assistance can be rendered. These are summarised as follows:— (1) Paying the fees for *employés*, or offering prizes to those who pass the examinations of the Board of Education, of the City Guilds' Institute, or the Society of Arts. (2) Increasing the wages of apprentices who have passed through an approved course of study, who attend regularly at approved evening classes, or who have passed approved examinations. Or instead of an actual increase in wages, increased efficiency may be recognised by promotion, or by transference from an inferior to a superior department. (3) Making concessions in the matter of working hours, so as to allow all *employés* the opportunity of attending classes. (4) Providing scholarships, or maintenance and fees, for a few selected and specially qualified students. (5) Taking part in the organisation of technical institutes or schools, and helping such establishments by personal supervision and interest.

TRUSTEE SAVINGS BANKS.—The report of the proceedings of the Inspection Committee of Trustee Savings Banks recently issued, shows that the period of twelve months covered by the report—November, 1903-1904—was not a prosperous one for Trustee Savings Banks, as although there was a slight increase of £170,000 in the Government Stock held on behalf of depositors in Trustee Savings Banks at the end of it, there was, on the other hand, a decrease of about £260,000 in the cash due to depositors, as apart from special investors. The explanation is not far to seek. In several towns, the local authorities are accepting small sums for deposit, offering a charge upon the local rates as security, at rates of interest which look very inviting compared with the 2½ per cent. to which Trustee Savings Banks are restricted by law. One county borough accepts deposits, as low as £10, at 3 per cent. interest. This tends to intercept the flow of small savings to the Trustee Savings Banks, and even to draw money away already deposited. Then certain joint stock banks are opening savings banks departments for the issue of deposit books, accepting for deposit sums of one shilling and upwards. "These competing agencies," says the report, "may have an important effect upon Trustee Savings Banks, whose hold, nevertheless, upon the industrial classes is a strong one, and the trust and confidence which is the growth now of close upon a century is not likely to be greatly weakened, provided the management keeps pace with the times, and trustees and managers can be found able and willing to continue their gratuitous services."

THE AREA UNDER WHEAT.—The anticipation that the area under wheat in Great Britain would show an increase in 1905 as compared with 1904, is confirmed by the preliminary statement for 1905, compiled from the returns collected on June 5th, and issued by the Board of Agriculture. The total acreage under wheat in 1905 is put at 1,796,985, as compared with 1,375,284 acres in 1904, an increase of no less than 421,701 acres, or 30·7 per cent. The acreage under wheat for the current year is higher than for any year since 1900, when it was 1,845,042. No doubt the rise in price has been the main cause of the increased acreage of the present year. The average price of wheat in 1904 was 28s. 9d. per imperial quarter, a higher average than in any year since 1898, when it was 34s. It is noteworthy that the present year's acreage of barley and oats shows decrease, the one of 6·9 per cent., the other of 6·2 per cent., as compared with 1904, and barley at the average price of 22s. 4d. per quarter, and oats at 16s. 4d. per quarter, were lower in 1904 than in any year since 1895 in the case of barley, and 1897 in that of oats.

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NOTICES.

PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principals laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1906, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

TELEPHONY.

By Herbert Laws Webb.

Lecture IV.—Delivered April 3rd, 1905.

Tariffs and Development.

The table shewing the comparison between a message and reply transmitted by telegraph and a message and reply transmitted by telephone (p. 1092), illustrates very pointedly the reason for the supremacy of telephonic communication. It is seen that work which takes an average of an hour and a-half, and requires for its completion numerous transactions on the part of a whole train of individuals and machinery, is done even more effectively by telephone in about a thirtieth part of the time. It is clear that for speed, directness and completeness, since the message and reply are handled in the one operation, the telephone service very greatly out-distances the telegraph service, which was the most rapid means of communication previous to the organisation of the telephone service. In addition to the great advantages of speed and completeness, the telephone service has the further advantage of being much cheaper than the telegraph. The minimum cost of a message and reply by telegraph is one shilling, and the average cost is slightly higher. The average cost to a telephone subscriber in this country of a message and reply is under 1d. for the local service, and the Post Office report shows that the average cost of a trunk telephone call is less than 6d. For local communication, therefore, the telephone service is cheaper than any other means of communication, cheaper even than the half-penny post-card.

In the long-distance, or trunk service, the charges as the distance increases are greater than the minimum charge for a telegram. But the trunk telephone service is really cheaper than the telegraph for the great majority of transactions, by reason of its greater carrying capacity. In a three minutes conversation by telephone, more matter can be transmitted or exchanged than could be transmitted or exchanged by telegraph for the same price. Comparisons of long-distance telephone rates with telegraph rates generally ignore this point, and contrast the rate for a three-minute conversation, which may contain 300 words, with the rate for a ten or twelve word telegram. Even where long-distance telephone rates really mount into large sums on account of the very long distances covered, as, for instance,

between New York and Chicago, where the rate is about 20s. for three minutes conversation, business people willingly pay the charge, because the service rendered is so great. In the longer distances, the telephone competes more with the railway than with the telegraph, as business men get direct interviews with each other, and so save the time and expense of the journey which would otherwise become necessary. It has been found since the long-distance telephone service has become a familiar part of business machinery, that many transactions which could not be completed by telegraph, but would necessitate a personal distance telephone service, in spite of its apparently high cost, is really a most economical method as a saver both of money and of valuable time.

For local communication in large cities, the telephone service is absolutely supreme, both on the score of rapidity and of cheapness. With whatever means of communication the comparison be made it is found that the telephone message, even when made at the highest price from a public station, is cheaper than the message transmitted by other means, and if all the various items of cost are taken into account it is cheaper than the average business letter.

TABLE I.—Comparison of Message and Reply by Telegraph and Telephone.

Telegraph.			Telephone.		
Steps.		Minutes.	Steps.		Seconds.
1	Writes message	2	1	Calls exchange	2
2	To telegraph office	5	2	Operator answers	5
3	Checking, affixing stamps	1	3	Receives number	3
4	Message to operator	1	4	Operator passes call to operator at distant exchange	8
5	Transmission (including time message is waiting its turn)	20	5	Distant operator connects and rings	5
6	Checking and addressing	1	6	Called subscriber answers	10
7	Delivery by messenger	10	7	Conversation: — Message and reply	120
8	Receipt of message	1	8	Disconnection signal	2
9	Writes reply	5	9	Lines disconnected	5
10	To telegraph office	5		Total seconds	160
11	Checking and affixing stamps	1		2 minutes 40 seconds.	
12	Message to operator	1			
13	Transmission (same as No. 5)	20			
14	Checking and addressing	1			
15	Delivery by messenger	10			
16	Receipt and reading	1			
	Total minutes	85			
	1 hour 25 minutes.				

interview, can be satisfactorily completed by telephone—which provides a personal interview, and saves the journey. To take New York and Chicago, as an example, the round trip from one city to the other and back, allowing a day for the interview, occupies practically three days' time and costs in expenses, approximately £15. The business man who can effect his object by using the telephone for fifteen minutes at the cost of £5, or even for half-an-hour at a cost of £10, willingly does so in order to save the three days' time, to say nothing of some saving in expenses. Even in distances of considerably less than a thousand miles, the same principle holds good—that the long-distance telephone service ... The high efficiency of the local telephone service, its great rapidity, the directness of the personal interview which it affords, and the completeness of the transaction, which embraces message and reply, or comment, in the one operation, and the extreme cheapness of the service, are the underlying reasons for the great development of the telephone service in all large cities where the service is effectively managed.

Requirements of the Telephone Service in Large Cities.

To give the telephone service its true value in large cities, the service must be highly efficient

and must be widely developed. The remarks above refer to the relative efficiency of the telephone in comparison with other means of communication. The efficiency proper of the telephone service means a rapid, accurate, and reliable service. It is essential that a city telephone service shall be reliable, that is, free from interruptions. One must always be able to count on the service being available at any moment of the day or night. Such a service, absolutely reliable and uniformly accurate and speedy, can only be provided by the methods which have been described in the previous lectures, namely, standard common battery switchboard and subscribers' station equipment, and a complete system of cable distribution. With such a plant, operated by a well-organised and well-trained staff, the delays, inaccuracies, and interruptions which in former years largely marred the efficiency of the telephone service almost wholly disappear. The design and construction of such a plant, involving the proper selection of sites for telephone buildings, the construction of adequate and suitable buildings and exchanges and of a distribution plant suitable to the area to be served, are matters calling for a high degree of engineering skill; and the maintenance of such a system, and the proper handling of the enormous volume of traffic which flows daily over a modern city telephone system, require the highest skill in organisation and management. But the science of telephony has progressed so far, both on the technical and on the commercial sides, that there is to-day no real difficulty in providing any city with a thoroughly efficient telephone service, capable of extension to almost indefinite limits.

In this country the ideal standard of telephone service has not yet been reached, though steady progress is being made in placing the telephone service of British cities on modern lines. It would hardly be appropriate in these lectures to enter deeply into the causes which have prevented the progress from being made in Great Britain with the telephone that has been made in the United States. The great difference may be attributed, broadly speaking, to the difference in conditions. In America, telephony is a free business; in this country it has been, from its earliest days, a Government monopoly, subject to the frequent changes of policy which occur under Government control, and for these reasons it has been impossible to develop the business on the broad lines which have been followed in America, where no question of Government monopoly or Government control exists to interfere with the normal development of the industry along business-like lines.

However, whether management of the telephone business be departmental or commercial, the real requirements and conditions of the business remain the same. In a large city, the standard of telephone equipment and service to-day is what has been described, and anything else is inadmissible. It is far more important to the community at large to have a highly efficient service and a widely developed service, one which can absolutely be depended on for speed and reliable working, and one which reaches the widest possible number of users, than to have a very cheap rate for any one particular class of service.

TELEPHONE RATES.

Telephone rates form a very controversial and complicated subject. The principal difficulty is that from the very beginning of the business the wrong unit has generally been adopted. The vast majority of people regard the telephone instrument as the unit of the business instead of the telephone message, which is the true unit. The general adoption of the "flat rate," or fixed annual charge for unlimited service, has been the cause of almost all the misunderstanding and controversy in connection with the vexed question of telephone rates. The adoption of the flat rate came about in a natural way, as the earliest telephone exchanges were combinations of owners of private telephone lines. The earliest use of the telephone was on private lines, and the next step was for a number of owners of private lines to combine their lines into an exchange, forming a sort of telephone club, each member of which paid an annual subscription for maintenance and service. In this way the flat rate became the accepted thing and the telephone became the accepted unit of the business. In very small places, where the average amount of plant in use for each subscriber is a fairly equal quantity, and the average amount of service rendered to each subscriber is also a fairly equal quantity, the flat rate is quite a suitable arrangement, but in large cities the conditions differ very greatly from those which obtain in small places. The amount of plant used by each subscriber varies greatly, and the amount of service rendered to each subscriber varies still more widely. The subscriber's telephone instrument is really only a means for using the service, and in no

way represents the amount of plant used by the subscriber or the amount of service rendered to the subscriber. To maintain flat rates in large cities is, therefore, to ignore the actual conditions under which the business is carried on.

The general adoption of the flat rate has been a fundamental error, and around this error there has arisen a long-drawn-out controversy which is frequently rendered still more obscure by the superficial and misleading comparisons which are so often made between rates in different countries and different cities. These comparisons are almost always misleading, since they do not take into account the wide and numerous differences in general conditions which exist, and very generally they are also inaccurate, comparing, for example, a rate for one class of service in one place with a rate for another class of service in another place. Comparisons of telephone rates in different countries are of little value unless all the details are known and all surrounding conditions are taken into account and fairly compared. The differences in conditions are generally so great and so numerous that it is a very difficult matter to establish comparisons that are of any real practical value. It is the experience of those who have given the most study to the subject that the only just method of judging telephone rates is in accordance with the actual conditions which obtain in the particular place where the service is furnished.

Although the flat rate is almost universally quoted in discussions of rates for telephone service, and most people speak of hiring or renting a telephone, yet there is a great variety in the methods of charging for telephone service in different places. In some places the subscriber pays an installation charge in addition to the annual rate. In others he pays the cost of building his line and then pays an annual rate. In others he has to buy his own instruments and pays an annual rate for the use of the line and for the service. In others he has to provide the instruments and to pay part of the cost of establishing the line. In all these cases the annual rate may be increased by mileage charges if the subscriber is more than a certain distance from the central office. The rate is sometimes higher for business service than for residential service, and in some places the rate increases as the number of subscribers in the system increases. In all countries it is the practice to charge higher rates in the large cities than in the smaller towns.

Then there is also a variety of schemes of message rates. The general principle of the message rate is that each subscriber pays in proportion to his individual use of the service, and undoubtedly this is the correct principle. There are two general methods of message rate; one in which the subscriber pays a fixed annual rate for the line and station plus a charge for each call originated, the other in which he pays a minimum rate for a certain minimum number of messages, the rate then rising in accordance with the annual number of messages used. A feature of this system is that the price per message diminishes as the number of messages used in a year increases. So far it has not been found practicable to charge a message rate pure and simple, *i.e.*, to install lines and telephones with no guarantee of use. Where this experiment has been tried it has been found in many cases that the use of the service by some customers has been so small as to make those customers unprofitable. No doubt in time the use of the telephone service will be so general, and the telephone plant in large cities will be so extensive, that it will become the practice to lay on the telephone service at any address without a guarantee of use, the customer to be charged simply for the messages which he originates. At present, however, we have not reached that stage in the development of the service.

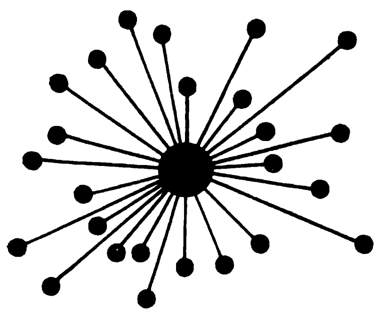
Several other varieties of telephone rates also exist in actual practice. In some cases it is the practice to make the subscriber pay the whole cost of establishing his line, and then to pay an annual charge for maintenance and a charge for service, the service charge varying in accordance with the number of subscribers available. A similar method obtains in some of the small co-operative companies which work in the rural parts of America and in the Scandinavian countries. Some of these systems are very cheaply constructed, usually with iron wire and often with second-hand instruments, and, as the subscribers very often do a large part of the work of construction themselves, and even keep their own lines in repair, a very small service charge for the upkeep of the exchange is required from each subscriber, and a very economical service results. Sometimes rates which obtain in this class of co-operative telephone system are quoted in comparison with rates for city telephone services operated

under entirely different conditions, and it may readily be seen that such comparisons can be of no practical value.

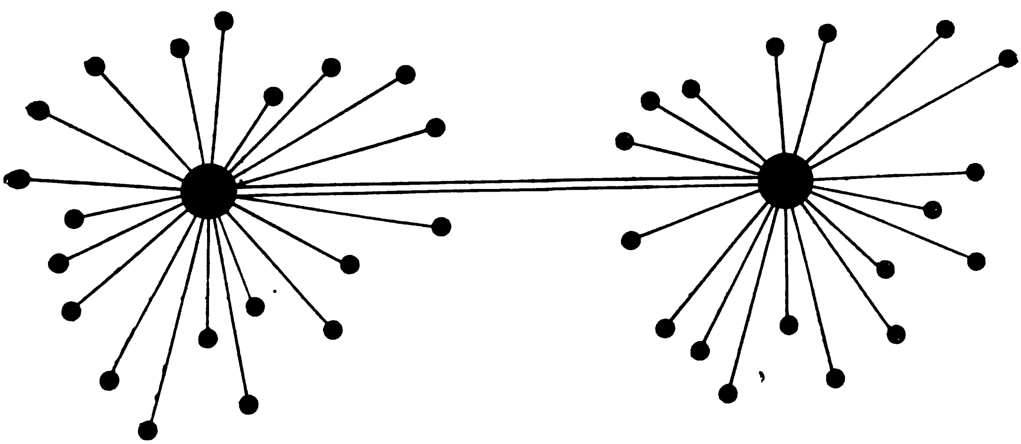
In general the principle that the message is the true unit of the telephone service is now fairly recognised, and the further important principle that the value of the message exchange, in which case the switchboard equipment is comparatively simple, and the length of travel of the message is limited by the combined lengths of the two longest lines in the system. When the size of the area is increased it becomes uneconomical to serve the whole area from a single exchange; then

FIG. 32.

SINGLE EXCHANGE AREA.



DOUBLE EXCHANGE AREA.



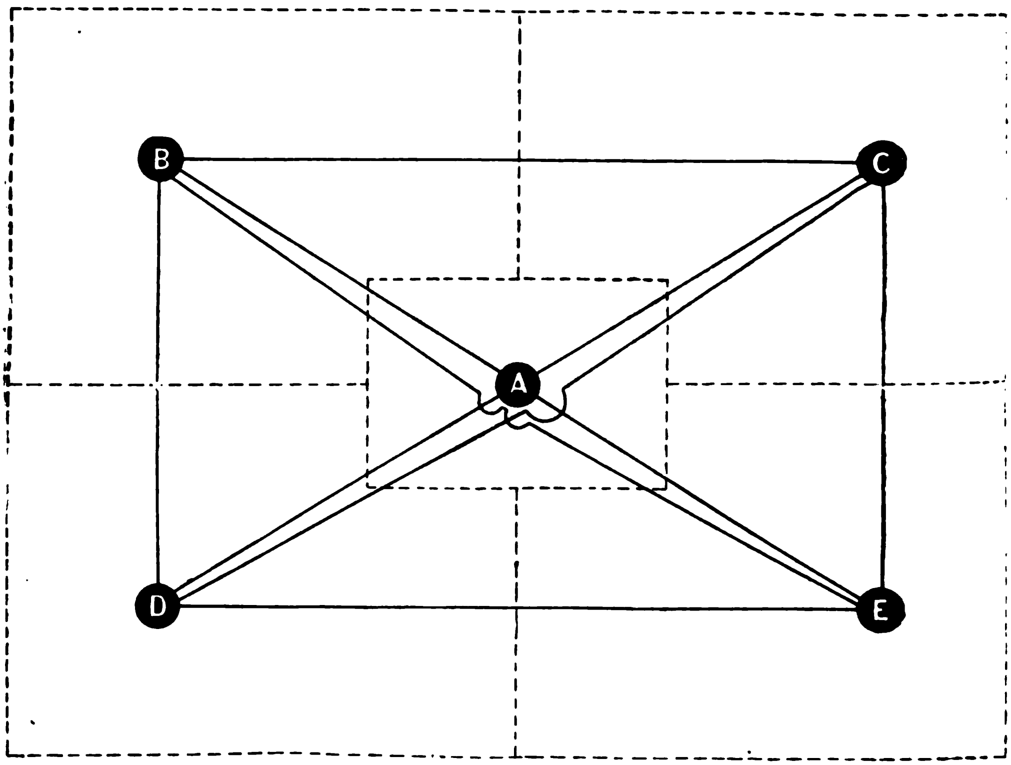
depends upon the size of the area served, which governs the actual distance travelled by the average message, is also becoming recognised.

The diagrams, Figs. 32 and 33, illustrate roughly the difference in the plant requirements of different sized areas. A very small area may be adequately served by a single two or more exchanges are installed, and the exchanges are interconnected by junction lines. This involves greater complication in the exchange equipment, as special equipment must be provided for operating the junction lines both at the outgoing and at the incoming ends, and it involves a greater amount of line plant per subscriber, as the

junction lines are additional to the subscribers' line plant. As the size of the area increases more exchanges have to be employed, the area being split up into districts, each district served by its corresponding exchange, and all of these exchanges must be interconnected by means of a comprehensive system of junction lines. The exchange plant of the large city system is very greatly complicated by the fact that by far the larger proportion of the traffic has to be passed over the junction line plant. The amount of equipment at each exchange which is required exclusively for the operation of the junction lines is a very large proportion of the whole exchange equipment, and this results in the city telephone exchange being of an entirely different character from the exchange which provides a purely local service. The actual amount of junction line plant in a large city telephone system is also a considerable proportion of the total line plant required, and this may readily be imagined when it is considered that in a large city in the case of three calls out of four the subscriber's demand is that his line shall be extended a distance which may range anywhere from one mile up to, in the case of London, 25 or 30 miles, in order to reach another subscriber's line in another part of the area. The diagram illustrating the plant conditions of a multiple exchange area gives but a feeble idea of the conditions of a large city telephone plant, in which there are many exchanges, every two of which must be directly connected by a complete junction line system. London affords the most unique example of the extensive and complicated plant required to cope with the telephone service of a large city. The London telephone district covers an area of 640 square miles, and within that area there are telephone exchanges distant 30 miles apart in a straight line. It is clear from these conditions that the telephone message must necessarily have different values in different places, since the range of travel of the message differs so widely.

FIG. 33.

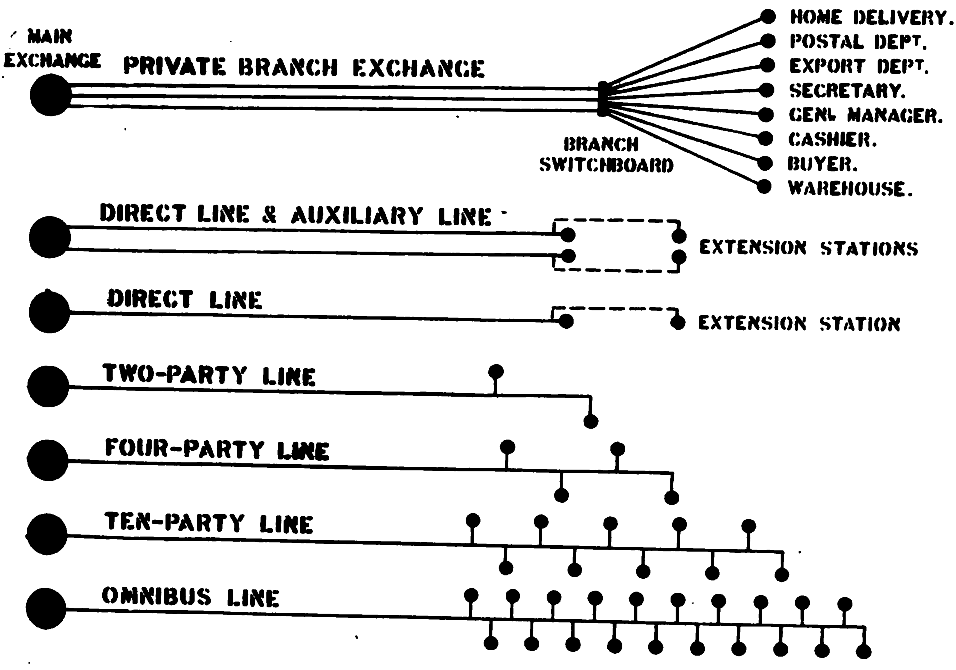
MULTIPLE EXCHANGE AREA.



The diagram, Fig. 34, illustrates the different classes of telephone service which are supplied to the modern telephone user. The variety of classes of service which may be supplied to the public illustrates again the uselessness of comparing telephone rates by the process of picking out one particular rate for purposes of comparison. As a matter of fact, the demands of different customers vary very widely, and in order to meet these varying demands, and to produce a comprehensive tariff which shall meet the requirements of all possible customers as regards price, as well as to suit the requirements of different customers as regards quantity and quality of service, the methods of supplying telephone service to the consumers have been largely modified. In the early days, the direct telephone line was the only class of line supplied to the public. As it was found that the line plant represented the largest part of the cost of establishing and maintaining a telephone service, the device of supplying two or more subscribers by means of one line was adopted as a logical method of arriving at a reduced rate for each of the several subscribers so supplied. This "party-line" service has been very largely extended in response to the demand for cheap rates, and whereas at first party lines were usually limited to two subscribers it is now the practice to supply as many as twenty small users by means of one main line, and in some of the rural districts of America an even larger number of stations is served by one line. On the other hand, some subscribers use the service very largely, and a single direct line is not adequate to supply their needs. The simplest means of relief for an over-worked line is to supply an auxiliary line, and to work the two on a double-track arrangement, using one line for outward messages and the other for inward messages. But there are many large businesses and large establishments which have so great a demand for the telephone service that no arrangement of direct lines, each attached to individual instruments, will fulfil the requirements. For such establishments the "private branch exchange" has been devised. This arrangement consists of a switchboard on the subscriber's premises connected to the nearest main telephone exchange by a group of two, three, or more junction lines,

FIG. 34.

DIFFERENT GRADES OF TELEPHONE SERVICE.



and connected to all the different departments in the subscriber's establishment which require to use the telephone service by extension lines and instruments. In this way an unlimited number of points in the one establishment can be directly supplied with the telephone service, and an unlimited amount of daily traffic can be handled expeditiously and satisfactorily. The flexibility of the system is obvious; the equipment can be increased or diminished according to the requirements of the traffic. The private branch exchange switchboard, served by one or more operators, acts as a distributor of the traffic, directing all inward traffic to the instrument of the particular individual wanted, and, in conjunction with the operators at the main exchange, directing all the outward traffic to its proper destination. The private branch exchange has very largely aided in placing the telephone service of large cities on a businesslike and thoroughly useful basis. This class of service is now a regular part of the equipment of all large business establishments and of large hotels and apartment houses or flat dwellings in American cities.

From the above discussion of the theory and practice of telephone rates, of the variation between the telephone plant of small places and large places, and of the variation between the demands of different individual consumers, it will be seen that there are three broad considerations which should govern telephone tariffs, apart altogether from the local conditions, which must be studied in order to arrive at the actual prices to be charged. These three broad conditions are:—the size of the area to be served, the amount of service supplied to each individual, and the class of equipment supplied to each individual.

It is clear that the size of the area must exercise a governing influence on the rates to be charged, since the size of the area governs the average distance the message has to be carried. That the rates should vary with the individual use of the consumer is such a commonsense principle that few will be disposed to quarrel with it. Finally, since different consumers can be supplied by different classes of equipment, one consumer requiring the most perfect arrangements possible while another is content with arrangements which are relatively inferior but fulfil his requirements, it is only practical business management to supply the service with such modifications in equipment as enable modifications of rate to be made to suit different purses.

Telephone Development in Different Countries.

The following tables (Tables II. and III.) show the relative development in the use of the telephone in the principal countries and in the chief cities or capitals of those countries. The relative telephone development in the

TABLE II.—Telephone Statistics, January 1st, 1905.

Country.	Population in Millions.	Telephones.	Inhabitants per Telephone.	Telephones per [illegible]
United States	76	3,400,000	22·2	44·[illegible]
German Empire	58	518,489	112	8·[illegible]
United Kingdom	42	365,198	115	8·[illegible]
France	39	122,191	320	3·[illegible]
Sweden	5·25	112,250	46·8	21·4
Austria-Hungary	48	74,600	644	1·55
Russia	135	60,000	2250	·4
Switzerland	3·3	52,509	62·7	15·[illegible]
Denmark	2·5	41,650	60	16·[illegible]
Norway	3	41,500	72·25	13·8
Holland	5·3	29,500	180	5·[illegible]
Italy	32	27,147	1180	·[illegible]
Belgium	7	24,750	284	3·[illegible]
Spain	18·6	16,000	1160	·[illegible]

TABLE III.—Telephone Development in Large Cities.

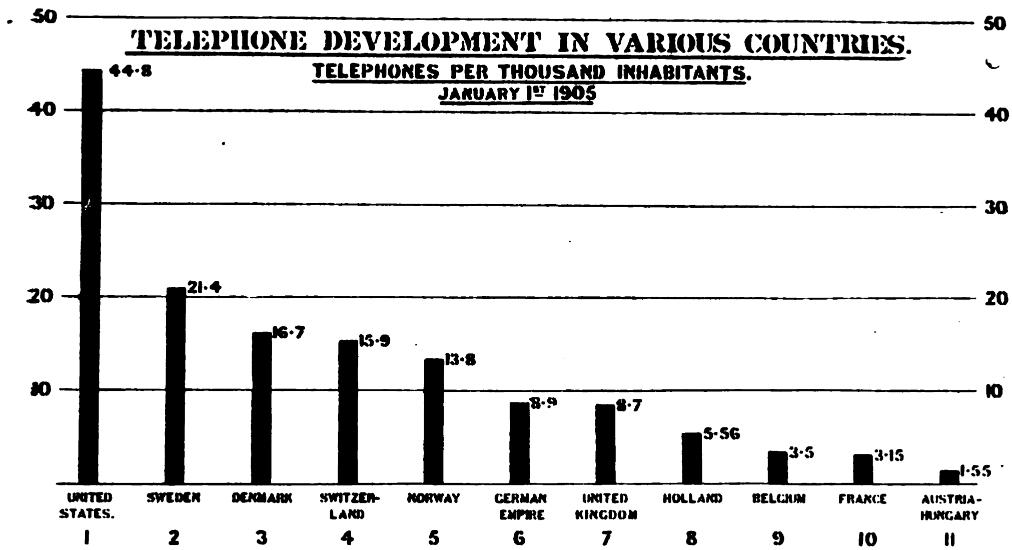
City.	Population.	Telephones, Jan. 1st, 1905.	Inhabitants per Telephone.	Telephones per [illegible]
New York	2,100,000	144,353	14·5	6·[illegible]
London	4,614,000	93,598	49·5	2·0[illegible]
Berlin	1,931,000	66,744	29	3·45
Paris	2,660,000	49,444	54	1·8[illegible]
Stockholm—Two systems	312,000	42,685	7·3	13·[illegible]
Stockholm—Company's system only	312,000	31,685	9·85	10·15
Copenhagen	476,000	23,000	20·6	4·[illegible]
Vienna	1,762,000	21,723	83	1·2[illegible]
Christiania	230,000	12,513	18·3	5·45
Brussels	576,000	7,829	73·7	1·3[illegible]
Budapest	800,000	7,500	106·5	·[illegible]
Zurich	153,000	7,275	21	4·[illegible]
Amsterdam	543,000	6,081	89·5	1·12
St. Petersburg	1,334,000	6,000	223	·45
Madrid	550,000	2,400	229	·43
Lisbon	370,000	1,740	212	·47

different countries and cities is also shown diagramatically in Figs. 35 and 36. It will be seen from these tables and diagrams that except in America there is no really high development of the use of the telephone. In Europe, speaking generally, the development of the telephone has been artificially restricted by the existence in almost all countries of a Government monopoly in telegraphy which has unfortunately been held to include the telephone. This has brought the whole telephone business under political control, and such control notoriously does not make either for commercial or for technical progress.

phone service has entered into the general life of the people to an extent that is not approached in any European country.

That under similar conditions similar results might have been reached in this country there is very little reason to doubt. With the same business-like policy of expansion and with the same enterprise in developing the service to the full extent of the public demand and even of educating the public up to the demand, as is practised in America, a very similar rate of development could be obtained in Great Britain. Such a policy has not been practicable here owing to

Fig. 35.



It is interesting to observe that the largest relative development of the telephone in Europe has been in the Scandinavian countries, and the relatively high rate of progress in these countries has been due to the fact that a strict Government monopoly in telegraphy either did not exist or has been exercised with less restrictive effect than in other countries.

In America the telephone has been entirely free from official control or interference, as there has never been a Government monopoly in telegraphy in the United States, and there has been no attempt on the part of the Federal Government to establish such a monopoly or in any way to impose restrictive regulations on either the telegraph or the telephone business. As a result the use of the telephone has been developed in a thoroughly business-like manner, and the employment of the tele-

the numerous restrictions arising from the Government monopoly. The relatively large development in the Scandinavian countries is an illustration of what can be done even in relatively poor and sparsely populated counties if private enterprise is allowed a fairly free hand. The large use of the telephone in Stockholm, which is frequently quoted in this country, is due to somewhat special circumstances, as for many years there has been an active competition in the telephone business in Stockholm between the State Telegraph Department and the Stockholm General Telephone Company. This has resulted in extensively advertising the telephone business in Stockholm, as each party to the competition maintains strenuous endeavours to secure new subscribers. The Company system is much the larger of the two, and continues to in-

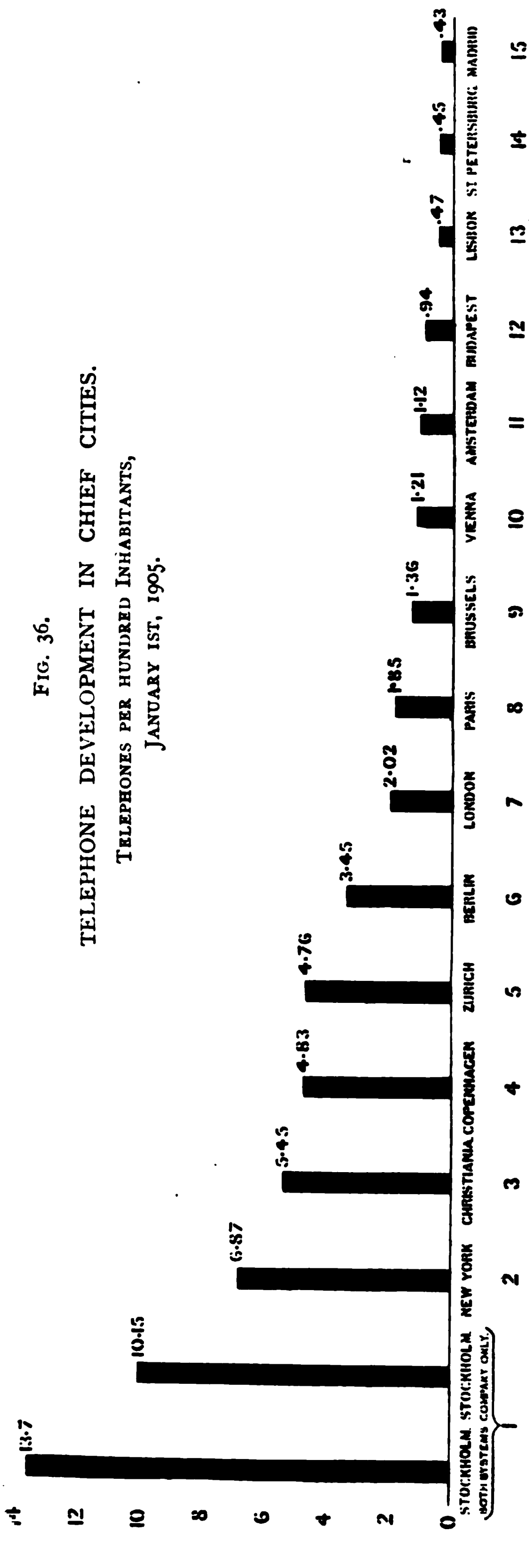


Fig. 36.

TELEPHONE DEVELOPMENT IN CHIEF CITIES.

Telephones per hundred Inhabitants, January 1st, 1905.

crease more rapidly, while a very large proportion of the subscribers to the State system are also subscribers to the Company system, thus involving the duplication of plant and subscriptions which is a familiar feature of all cases of telephone competition.

To achieve a sound and efficient development of the telephone service, there are several essential requisites peculiar to the telephone business which are little understood in European telephone administrations owing to the unfortunate fact that political control, too prone to take matters for granted, has discouraged in Europe the study of telephony as a specialty. Properly to develop the telephone service of a large city, with due regard to economy and efficiency, needs high engineering skill to lay out a very complex and costly plant in accordance with the requirements of the population, and on such lines that it may be developed economically with the growth of the population. To secure efficient maintenance of the whole system of delicate switchboard apparatus and numberless ramifications of wire plant, and to maintain a reliable and efficient service, needs expert supervision of a high order and a highly-trained staff especially adapted to the work. To exploit the service as a business, and to educate the public to its value and how to get the best results from it in actual use, needs a business management and organisation of a very high order. It is, unfortunately, the fact that these essential characteristics—which almost amount to laws—of telephony as a business have been very largely ignored and neglected by European telephone administration.

One great difficulty connected with the development of a large telephone system is that it must be conducted with an eye to the future. To develop scientifically and economically needs a very careful study of the distribution of the population and of its probable future distribution, of the growth of the population, of the number and distribution of the probable future subscribers, and of the volume and probable distribution of the future traffic. Without a very careful study of the probable future conditions along these lines the development of the plant cannot be undertaken either effectively or economically. If no such study be made the result assuredly will be waste and inefficiency.

Owing to the lack of scientific study of the conditions of future development, there is hardly a city telephone system in Europe today which is capable of taking care of the

actual business which offers, and there is not one, unless it has been completely rebuilt during the past few years, which is capable of indefinite development along economical lines.

A very important feature of the city telephone system is that it must contain a large margin of spare capacity, not only because there is constant growth going on which must be provided for, but also because there is constant change in the telephonic population, to cope with which requires a flexibility in the plant, which can only be obtained by having a margin of spare facilities in all directions. It is not uncommon, owing to old subscribers going off and new ones coming on in different places, owing to removals and to changes in the amount of telephonic equipment required by different subscribers, for a telephone system to be required to make three changes in the plant for every single new station gained. As an example of this, in one city there were in a period of less than a year 12,981 new stations put in and 7,456 stations taken out, making a total of 20,437 changes in the plant for a net increase of 5,525 stations. Figures on a similar scale would be obtained from any large and progressive telephone system. Unless there is a large margin of spare facilities, so that the new subscriber can be taken on wherever he offers and the line of the discontinuing subscriber held vacant until another customer appears, and so that the service can be changed from one address to another without difficulty, the public is not properly served and the service is not an efficient one in the full sense of the word. Therefore, these spare facilities are required not alone for future development, but to carry on effectively the business from day to day. In various city telephone systems in different parts of the world the provision for the future is so small that not only is the development of the service practically arrested, but proper facilities cannot be given for the changes that are daily required to meet the varying demands of different subscribers. In some places it is not uncommon for the line of a subscriber who for some reason wishes to give up the service to command a high premium, so great is the demand for the service among business people and so restricted the facilities for supplying it. In some places there are actually more applications on file for the service than there are subscribers connected. These are extreme examples of what occurs when a business is operated under artificial conditions.

That the direct usefulness of the telephone service to a very large proportion of the public and its indirect value to the community at large entitle the telephone to much more intelligent and enlightened treatment than it at present receives in most European countries has perhaps been partly demonstrated by these lectures.

In the course of the lecture several slides were shown in which the area of London was contrasted with the area of other great cities. It would hardly be useful to reproduce these slides, but they showed that no other of the world's great cities approaches London in the size of its area. The area of Paris is 31 square miles, or about ·05 of London. Berlin is 28 square miles, Vienna 21, St. Petersburg 20, and Manhattan and the Bronx, or old New York, 62 square miles. Greater New York, which comprises Brooklyn and Staten Island, and is served by three separate telephone systems, all intercommunicating however, covers a total area of 307 square miles, or a little less than half the London telephone area.

Most hearty thanks are due for the loan of apparatus, lantern slides, and for other facilities, to Mr. John Gavey, C.B., Engineer-in-Chief, G.P.O., to the National Telephone Company, the General Electric Company, and the Western Electric Company, and to the British Mutoscope and Biograph Company for the interesting moving pictures of a telephone exchange, made by permission of the National Telephone Company, which were used to illustrate the third lecture.

GRADUATED INCOME TAXES.

At the instance of the Treasury, His Majesty's representatives abroad have compiled a series of reports respecting graduated income taxes in foreign States. These reports have just been published (Cd. 2587), and they are prefaced by an interesting report by Mr. Bernard Mallet, Commissioner of Inland Revenue, who has classified and summarised the information received. Before referring to the very various systems adopted by foreign States it may be convenient to mention the States which dispense with an income tax. In France there is at present no graduated income tax, or indeed any impost in the nature of an income tax except the "contribution personelle mobilière,", the doors and windows tax, and the tax of 4 per cent. on incomes derived from all kinds of securities, such as shares of companies or debentures, excepting interest on State funds, French and foreign. In Russia there is no income tax proper. In Portugal no attempt is made to tax the income of the taxpayer as such. No income tax proper can be said to exist in Belgium, the only State tax in any way resembling an income tax being that of 2 per cent. levied on the dividends of joint stock companies. In Hungary there is no tax,

whether graduated or not, corresponding to a general income tax such as in force in England. In the United States no income tax is levied. A statute was enacted by Congress in 1894 providing for a general tax on incomes derived from all sources, but by decision of the Supreme Court, in the case of "Pollock *v.* Farmers Loan and Trust Company," such a Federal tax was declared to be unconstitutional. Nor is any income tax levied in any of the States of the Union, with the exception of North Carolina, where a tax of 2 per cent. is payable on income derived from all sources in excess of 1,000 dols.

In States where an income tax is levied it differs widely in general character. In no two countries is it identical or near it. Some of them are taxes affecting the whole income of the taxpayer, such as the Prussian income tax, while others are designed either to supplement existing taxes, or to fall only on certain sources of income which are not reached by such taxes. In no foreign State is the maximum of exemption anything like so high as in the United Kingdom; in all foreign States there is graduation, and in most differentiation. As to graduation, the principle adopted may be the exemption or partial exemption of the smaller incomes, or of certain classes of income tax payers, or by some more regular system of progressive taxation, or by both methods. Differentiation taxes "unearned" income, that is to say income from property or investments, at a higher rate than income from personal labour, and this may be effected in various ways; for example, either by taxing different kinds of income at different rates, or by a combination of a tax on realised property with a tax on income proper. The income taxes described in the Reports are all State taxes as opposed to taxes levied for local purposes. Two main groups, the German and Swiss taxes, are imposed by States belonging to a confederation, but these taxes all form State and not local revenue. In neither of these cases does the Federal Government at present levy an income tax.

The exemption of a certain minimum income is a principle recognised in one shape or another in all the States reported upon, but the limit of exemption differs widely. It is highest in Holland at £54, lowest in Norway at £18. In Austria it is £50. In Prussia and Bavaria it is £45; in Denmark, according to locality, £33, £39, and £44; in Spain, for private individuals, £45, and for State *employés*, £31. In Italy, differentiation takes its most elaborate form. By it incomes are classified according to their character, and "discrimination" is applied by which the net or taxable income is reduced in the following proportion:—(1) Incomes are assessed at their integral value, and pay the full tax of 20 per cent. This class comprises interests on capital, and perpetual revenues, owed by the State (*i.e.*, mortgages, ground rents, fixed annuities, &c.), interests and premiums on communal and provincial loans, dividends of shares issued by companies guaranteed or subsidised by the State lottery prizes. The rate in this category is 20 per cent. (2) Here the income assessed is reduced to 30-40ths of the actual income in this class, which consists of all incomes derived from capital alone, and all perpetual revenues which do not come under category 1. This is equivalent to a rate of 15 per cent., increased in all the categories by two centesimo per cent. to cover expenses of verification and collection. (3) Income is reduced to 20-40ths in this category, which consists of incomes derived from the co-operation of capital and labour, *i.e.*, those produced by industries and commerce. The rate is therefore 10 per cent. (4) Income is reduced to 18-40ths when derived from labour alone (private employment) and those represented by temporary revenues or life annuities. The rate is therefore 9 per cent. (5) The income is reduced to 15-40ths in the case of salaries, pensions, and all personal allowances made by the State, the provinces, and communes. The rate is 7½ per cent. The average rate of the tax works out at something like 12 per cent. Incomes under categories 3, 4 and 5, not taxed at the source, and which do not exceed £16 after the reductions have been made, are exempt from taxation. No minimum is exempt under categories 1 and 2. The Spanish tax is remarkable in that "the scale of taxation on property is, as a rule, lower than that on personal exertion." Unearned incomes and mixed incomes are taxed at rates varying from 20 per cent. down to ½ per cent. in a manner designed to be roughly proportionate to the profits of specific enterprises; on the other hand the earned salaries and pensions of State officials and of generals in the army are taxed, not universally at the lowest rate as in Italy, but at the high rates of 20 per cent. and 18 per cent. Relief, therefrom, is however, afforded for smaller incomes of this class by graduation, and the graduation is such that the poorest incomes of the class (£30 to £45) pay only two per cent. instead of the full rate of 20 per cent. and 18 per cent. Earned incomes from commercial and other civil occupations are taxed at one of two rates—10 per cent. and 5 per cent. A whole class of earned incomes, however which in Italy falls under the income tax is omitted altogether from the scope of the Spanish tax on "incomes from personal property." While the profits and *employés* of banking, railway, and insurance companies, and indeed of public companies generally, are included in it, ordinary individual trading and professional incomes are taxed under an older and quite different law, that of the tax or the "exercise of industrial, commercial, and professional enterprise." This tax, being based on the character of the business and the population of the locality in which it is carried on, is analogous to the French "Loi des Patentes." It is an "industry" tax not an income tax.

In Russia an earned income of £56 pays ·67 per cent., an unearned pays in all 1·92 per cent.; an earned income of £150 pays 2 per cent., an unearned pays in all 3·25 per cent.; an earned income of £500 pays 3 per cent., an unearned pays in all 4·25 per

cent.; an earned income of £5,000 pays 4 per cent., an unearned pays in all 5·25 per cent. In Saxony the differentation is almost identical with that of Russia, in Wurtemberg it is greater in the proportion roughly of 8 to 5. In Denmark an unearned income of from £166 to £222 is taxed twice as heavily as the earned income of that amount. For lower incomes (down to the limit of exception) the differentiation is slightly greater, for higher incomes it becomes less, the rate of an unearned income of £5,550 or over being only 1·6 times the rate for a corresponding earned income. In the Netherlands and Bavaria there exist separate graduated taxes, the one affecting earned income only, the other affecting unearned income only. In the Netherlands the rate for a pure industrial income is less than that for a pure unearned income of the same amount in a fixed proportion of (approximately) 3 to 5. For mixed incomes, derived partly from labour and partly from property, there is a special arrangement, the earned portion of it being taxed more heavily than a pure earned income of the same amount unaccompanied by income from property. As in most other countries, so in Switzerland, the differentiation is most marked in the case of the smaller incomes. For an income of £40 the least differentiation is found in Valais and the greatest in (if Bâle-ville be excluded) Uri, where an unearned income of that amount is taxed no less than 16·67 times more heavily than a corresponding earned income. For an income of £400 the least differentiation is in Grisons, where the proportion is 118 to 100; in Bâle-campagne the differentiation is the proportion of 412 to 100. For an income of £4,000 the greatest differentiation is in Bâle-campagne, where an unearned income of that amount is taxed 4·12 times more heavily than an earned income. On the other hand, in the Grisons an exceptional application of the principle of differentiation involves the taxation of an income of £4,000 higher if earned than unearned. The rates here contrasted are those applicable to pure labour incomes and pure property incomes respectively. As such they represent the extremes of the differentiation. There is, of course, a large class in every community possessing a "mixed" income.

Three different methods of assessment and collection are exemplified in the Reports—(1) that of assessment on the declaration of the individual taxpayer; (2) assessment by the taxing authority from such information as it is able to obtain without compulsory declaration; (3) assessment, where possible, of the income in the hands of its first possessor, or collection "at the source of income," with the right of deduction, as understood in this country. Compulsory declaration is the general rule in Germany, Switzerland, the Netherlands, Sweden, and Denmark; assessment by the taxing authority in some of the Swiss Cantons and in Norway; assessment at the source in Austria and Baden. In the latter, for instance, it is applied to the salaries of minor State officials, and to the workpeople employed by large contractors, who pay and deduct the tax on wages. In Austria, "fixed salaries" and wages where the tax is collected from the *employés*, are also taxed at the source. A more important instance is the assessment of companies to income tax, a usual feature in foreign income taxes. When the profits of a company or corporation are taxed like those of an individual, and the dividend for distribution thereby diminished, the tax must be held to fall upon the latter, who, when they are also obliged to return the amount of this dividend with the rest of their income for assessment, may be taxed twice over for this portion of it. Double taxation of this kind is obviated in Norway, where the taxpayer is not personally assessed on the income he derives from companies, and in Hesse, where in making his return of income he deducts income derived from profits distributed by companies. In other States some partial exemption is made to mitigate the double taxation which would otherwise occur. In Prussia, Baden, and Sweden, for instance, only the profits of a company over a certain fixed percentage of the capital are subject to the tax. In Saxony, however, no provision of this kind is to be found. In Italy, the assessment of incomes from private industries, trades, or professions or from companies with unlimited liability, is on an average of two years, in all other cases it is on the income of the current year, or, as in the case of limited liability companies, on the basis of the accounts closed before the previous July of the current year. Collection is generally in the hands of the State or local officials paid by fixed salaries. Italy and Spain, hower, afford exceptions. In Italy there are collectors (for the communes) who collect the sums owed from the *employés*, and send them forward to the provincial Receivers (for the provinces), who also receive a percentage, and pay the income tax to the State. In Spain, the tax is collected by the same officials charged with the collection of other taxes.

SUNDAY TRADING.

There is a general impression that Sunday trading is on the increase, but probably few have any idea of the extent to which it has grown in recent years. The evidence taken by the Select Committee of the House of Lords on the Sunday Closing (Shops) Bill, and just published, is conclusive as to the growth of this trading. In London it is found more especially in districts largely inhabited by Jews, such as Whitechapel and Stepney, but in great provincial towns like Liverpool, Manchester, Belfast, Glasgow, it seems to be general. In his evidence before the Committee, Mr. Edwin Openshaw, chairman of the Manchester and District Meat Retailers' Association, said that within a radius of 12 miles of Manchester, from a rough estimate taken, there are some 15,000 shops open, and some 25,000 people employed in these shops of all classes, and the vast majority of them would be glad to close on Sunday, provided

they all closed. Taking Manchester and Salford only, Mr. James Kendall, the secretary of the Manchester, Salford, and District Grocers' Association said that in order to ascertain the amount of Sunday trading the whole area was divided into some 50 districts, that on two given Sundays these districts were canvassed, and it was found that 6,498 shops were open on that particular day. It was not a complete canvass because one of the districts was not canvassed. Not only has the number increased, but the system on which the business is carried out is very different to what it was ten or twenty years ago. Then the shopkeepers did their business in a sort of apologetic way; they left the door on the latch, then they opened the door, then they pulled the shutters down. "Now," says Mr. Kendall, "We have a shop in Manchester, a butcher's shop, where six men are employed all Sunday morning, where meat exposed outside on the pavement, and where, on the Sunday that the canvass was taken, at one time there was no less than between 50 and 60 customers." On the day of the canvass, in a triangular area of not more than half a mile on each side, 171 shops, excluding 42 licensed premises, were open for business on the Sunday morning, and doing a thriving trade. That is in a working-class district, where all the men receive their wages at noon on Saturday, this volume of Sunday trading was going on, not because the working man cannot accommodate himself to it, but because it gives him a Saturday afternoon for pleasure and relaxation, and he knows he can get his stuff on Sunday morning, and it makes him indifferent whether he shops on Saturday or not.

It is much the same in Liverpool. A report as to Sunday trading was taken at the instance of the Watch Committee by the police, with the following result:—The number found to be open was between 4,000 and 5,000; 25 per cent. were sweet shops, and were open all day. The herb beer and refreshment shops numbered nearly 500. Tobacco and stationery accounted for another 1,000, and these show an increase of about 100 in the afternoon. Then there were grocers, greengrocers, and butchers, and they represent slightly over 1,000. They were open in the morning. They dropped down 50 per cent. in the afternoon, the number of butchers dropping from 205 to 22. Then the milk dealers—540 in the morning and 467 in the afternoon. The barbers were 109 in the morning and 13 in the afternoon; street vendors, 199 in the morning and 128 in the afternoon. With the exception of tobacconists and paper shops, there is a decrease after two o'clock. The shops open in the afternoon were less than two-thirds of the morning number, 3,908 in the afternoon and 4,581 in the morning. And as in Manchester, the old sense of wrong-doing seems to have disappeared. "We find," said Mr. J. Charles, President of the Liverpool Tradesmen's Conference, "that the number of Sunday sellers is increasing, and not only that, but they are opening now without any fear or sense of shame or decency. The shops are open, the shutters are down, and the trade is carried on on Sunday the same as any other day of the week."

The experience of Belfast is similar. "Including spirit grocers," said Mr. T. G. Perry, President of the Belfast and North of Ireland Grocers' Association, "and the general traders that open on Sunday, we have about 1,000 places on Sunday, either for the whole day, or part of the day, engaged in trade." But perhaps the most remarkable illustration given of the growth of Sunday trading was furnished to the committee by the figures submitted by Mr. Kenneth M. Milligan, Chairman of the Scottish Shopkeepers' and Assistants' Union. The total number of shops in Glasgow, as given by Mr. Milligan, that are occupied is 16,651, and the total number open on the Sabbath day is 3,040. Sunday trading is increasing from year to year. It is curious, that of the 3,040 shops open in Glasgow on Sunday only four are those of barbers. The greatest increase has been among shops for the sale of aerated waters, sweetmeats, ice cream shops, and all the other class of shops of that kind.

The figures given above show that the growth of Sunday trading in the great provincial towns has been very large. In London, in certain districts, it is much larger, but it seems to be less diffused, and more attributable to the presence of large numbers of Jews. This is particularly the case in Whitechapel and Stepney. In his evidence, the Rev. Alfred Poynder, Vicar of Whitechapel, told the Committee that "between 30,000 and 50,000 on a Sunday morning, who are not of the alien population, do their shopping in our streets, and crowd our neighbourhood right up till noon, practically converting the whole of the morning into an enormous fair. We have hat shops, boot shops, clothing, and other kinds of shops open. The British population say they would lose their custom in a great measure if they in self-defence did not open on the Sunday." Mr. Douglas Eyre, who has been Resident at the Oxford-house, Bethnal-green, for many years, and is now Vice-Head of the House, said that Sunday trading has increased to an enormous extent in that area during the last few years; a great number of the stall holders are not Bethnal-green traders at all, but come from other boroughs where such trading is not allowed. They often bring with them food stuffs which they have failed to sell in other markets, and the borough is discredited by the amount of stolen property in the market, and by the persons of undesirable character which such trading attracts. In no part of London can such a concourse of people be found, says Mr. Eyre, as that gathered together in Bethnal-green on Sundays between the hours of 10 and 2. They come from all parts and portions of the district of Bethnal-green and of Spitalfields, and constitute a regular Sunday fair. "In Bethnal-green there is a great deal of selling of meat and vegetables going on till after one up to almost two o'clock. There is a great trade in cycles, and it is the recognised place in East London for anybody to go on Sunday

who requires a new tyre to be fitted to his cycle. There is an extensive market for the sale of dogs, conducted by labouring men as well as ordinary professional dog sellers. Then there is a large amount of trade in the quack doctor line—pills, and things of that kind, and quack medicines. There is a big trade in birds of all kinds, pigeons and fowls, parrots and canaries. In Middlesex-street there is an immense sale going on in old clothes, watches, trinkets, race cards." "The mass of people," says Mr. Eyre, "gathered together at the top of Bethnal-green is such that it is very difficult for omnibuses and others at some parts of the Sunday to pass down the road at all. They are obliged to go at a very slow walking pace."

The vicar of St. Mark's, Walworth, the Rev. Francis Forster, speaks of a very similar district in his own parish—East-street, Walworth, close to his church—where a market very similar to the Petticoat-lane market exists. There is an enormous influx on the Sunday from all parts of London into the street, both as buyers and sellers, and a very large trade done mostly in the non-necessaries of life, such as poultry and birds, toys and old clothing, and there the small shops, the greater part of the street consisting of them, keep open in defiance of the costermongers. Sunday is under these circumstances a day on which a very much larger amount of business is done than on any other day of the week. In the main roads of Walworth there is not much Sunday trading, and what there is is almost conclusively confined to sweet shops, and ginger-beer shops, and fruiterers.

The Committee are convinced by the evidence not only that Sunday trading is very largely on the increase, but that an Act for restricting it is urgently needed and desired by the shopkeeping interests. Moreover, that such an Act would not inflict serious hardship on the poorer classes if due regard were had to certain necessities, which might be met if the Local Authority, with the consent of the Secretary of State, was able to exempt particular areas from the provisions of the Act if in its judgment, owing to any special circumstances, it would press with undue and exceptional severity on the general body of the traders and their customers within the district. Of course the difficulty in places like the Metropolitan districts mentioned above is that the trade is very largely in the hands of Jews, who are not allowed by their religion to trade before sundown on Saturday, and as a matter of practice are accustomed to use the hours after sundown on Saturday for the purposes of recreation. This point was put by Mr. Abraham Valentine, who spoke as the representative of the Costermongers' Street Sellers Union,—"The Jewish people," he said, "generally take their recreation on Saturday nights, when their Sabbath terminates. I myself am closed during the year as follows:—Fifty-two Saturdays, fifty-two half-days (Fridays). There, perhaps, I may make a little correction. In the summer time on the Friday it would vary from about 5 o'clock to about 7. In the months of June and July we could keep open till 7 o'clock, but in the winter time we should close, certainly at half-past three. . . . The compulsion would be directed against the Jews only, for the Christians can get their six days' labour without working on their Sabbath." The answer would be, as pointed out by members of the Committee, that in opening on Sunday the Jew is breaking the law of the land in which he lives, and driving his Gentile neighbour to open on the Sunday. As to the law as it stands, the Act of Charles II., there was general agreement among the witnesses that it is not deterrent. It imposes a tax of 5s. only, which is absolutely inadequate, and there is much prejudice and popular feeling against putting it into operation. For the purpose of prosecuting Sunday traders one particular portion of the Act has to be selected. It also enacts that any person who does not go to church or chapel on Sunday shall be punished and fined equally, and it is objected that if one part of the Act is treated as obsolete, it is invidious to put the other into force. However that may be, the Committee are of the opinion that a more stringent law passed in these days would adapt itself specially to deal with the evil, and they have reported that in their opinion Lord Avebury's Bill "would be a great benefit to the country generally, and commends itself both to the reason and the conscience of the community."

FOREIGN TRADE OF INDIA.

In his exhaustive report on the foreign trade of India for the official year ending March 31st last, Mr. J. A. Robertson, late Director-General of Statistics to the Indian Government, explains in detail the bearing of the figures on this subject which were published in June. The imports of merchandise during the year amounted to £64,450,000, compared with £56,548,000 in the year preceding, while there was an advance in the value of the exports from £99,756,000 to £102,751,000. In 1903-4 the export trade received an abnormal stimulus owing to the exceptional demand for and high price of raw Indian cotton, while the imports were influenced in the opposite direction consequent on the partial paralysis of the Lancashire cotton industry, due to the shortness of the American supply, which resulted in a great decrease in the importation of cotton manufactures into India. In 1904-5, on the other hand, the extraordinary abundance of American cotton brought with it exceptional prosperity for the Lancashire mills, and the revived Indian demand for cotton goods exceeded all previous records. Imports of cotton yarn and fabrics in 1904-5 thus increased in value by 22·7 per cent., while the exports of raw cotton fell by 28 per cent. The importation of other textile goods was also beyond precedent,

the total Indian purchases of all yarns and textile fabrics reaching the sum of £29,053,000, representing 45 per cent. of India's total imports of merchandise. The expansion of the import trade, moreover, was general, and on this head Mr. Robertson remarks:—"The value of the imports of mechandise in 1903-4 was greater than in the preceding year by 603·5 lakhs (£4,023,000), or 7·6 per cent., and in 1904-5 there was a further advance of 1,185.5 lakhs (£7,903,000), equal to 14 per cent. So large an increase as 1,789 lakhs (£11,926,000) in two consecutive years is unrivalled, and no other year has witnessed quite so large an absolute increase as 1904-5, though it was approached by the increase of 1,057 lakhs (£7,046,000) in 1880-1, in which year a brisk revival of trade marked returning prosperity after a period of widespread distress and famine, and almost equalled by an advance of 1,135 lakhs (£7,566,000) in 1893-4), when the temporary stimulus to imports given by the closing of the mints on the introduction of the currency reform raised their value far above that attained in any of the seven succeeding years." How remarkable has been the progress of the Indian import trade is shown by the fact that although 1880-1 was exceptionally prosperous, the total for 1904-5 was 92 per cent. greater than in that year; in other words, the imports almost doubled in the course of a quarter of a century.

The export trade was marked by the decrease in raw cotton, already mentioned, but, on the other hand, the shipments of wheat, rice, and other food-grains were unparalleled. The wheat exports increased in value by 698 lakhs (£4,653,000), and those of all grains by 851 lakhs (£5,673,000), while as regards quantity the total shipments of wheat reached 43,000,000 cwts. compared with 25,911,000 cwts. in 1903-4, and 10,292,000 cwts. in 1902-3. Of the wheat exports last year 67 per cent. was shipped to the United Kingdom. The estimated yield for the present season is, owing to the unusual circumstance of severe frosts, one-fifth less than that of a year ago, but there will still be a large surplus for export. Estimated by value, the shipments of raw jute, raw skins, raw wool, cotton manufactures, jute manufactures, and lac in 1904-5 were the largest on record, while the quantities of tea, coal, and seeds were larger than in any previous year. Spices, indigo, vegetables, raw silk, and dressed skins, however, recorded a decline.

An examination of the details of the import trade shows that larger purchases of sugar, machinery, raw cotton, and textiles were mainly responsible for the increase in the various classes into which the imports are divided. A decrease in the purchases of oils has been continuous for three years past, and is due to the increasing consumption of indigenous mineral oils refined in Burma and Assam. The expansion in the imports of sugar is very remarkable, the total quantity taken last year amounting to 6,549,797 cwts., compared with 6,038,115 cwts. in the year preceding, and 4,987,195 cwts. in 1902-3. Beet sugar rose in quantity from 552,737 cwts. to 1,716,488 cwts., while there was a decrease in the imports of cane sugar from 5,485,378 cwts. in 1903-4 to 4,833,309 cwts. in 1904-5. Java now occupies first place in the Indian sugar market, the quantity received from that source during the year being 2,546,000 cwts., or 38·9 per cent. of the total imports. The tariff preference given by the United States to Cuban sugar, and the recovery of the sugar industry in that island, had deprived Java of its assured position in the American market, and in 1903-4, when shipments to the United States declined, a portion of the crop was diverted to India. In 1904-5 the Java crop was exceptionally large, and the shipments to India increased simultaneously with large purchases by American refiners. Austria-Hungary contributed 1,441,240 cwts. of beet sugar as compared with 299,259 cwts. in 1903-4, 880,018 cwts. in 1902-3, and 2,257,928 cwts. in 1901-2, when abnormal shipments were made in anticipation of the additional countervailing duties. The subsequent decision of the Indian Government not to maintain countervailing duties against any country which is a party to the Brussels Convention resulted in the revival of the imports from Austria-Hungary indicated by the figures quoted. Imports of sugar refined in the United Kingdom, on the other hand, fell from 637,277 cwts. in 1903-4 to 121,348 cwts. in 1904-5. This trade, which has so largely decreased, was the outcome of the advantages conferred upon cane sugar by the repressive legislation directed against the introduction of the bounty-fed article, and its diminution is due to the withdrawal of the restrictions by the Indian Government.

In the imports of hardware and cutlery there was, last year, an increase of about 3 per cent., bringing up the total increase for the past ten years to 87 per cent. The United Kingdom's share of this trade is equal to 64·7 per cent., while that of Belgium and Germany combined is 18·5 per cent. The imports of copper fell by 1·3 per cent. in quantity and 2·7 per cent. in value, the rise in price having checked this trade. Iron showed an increase of from 232,570 tons to 257,580 tons, but steel decreased from 226,335 tons to 211,581. It is intimated, however, that the distinction drawn in the statistical returns between common bars, plates, and sheets of iron and steel respectively is not wholly trustworthy. Of India's imports of these manufactures last year, 65·8 per cent. in quantity and 65 per cent. in value came from the United Kingdom. The value of the machinery and millwork imported reached the unprecedented total of 402¾ lakhs (£2,685,000), which is nearly 15 per cent. above that of the previous record. The imports of railway material, on the other hand, showed a slight decrease as compared with 1903-4, which was a record year. Kerosene oil decreased to the extent of 2·6 in value, although the imports increased by 6 per cent. in quantity. The Burma Oil Company, which monopolises the Burma oil trade, is, Mr. Robertson states, rapidly expanding its business, and with the projected increase of £1,000,000 will have an authorised

capital, including debentures, of £3,000,000. As regards coal there was an increase of 40 per cent. in the quantity imported, this being attributed to excessively low freights and the depression in the British coal trade. The total of private imports was 252,400 tons, while the production of Indian coal in 1904 reached 8,212,000 tons, an advance of 10 per cent. on the previous year. The division of the import trade among the principal countries in the past five years was as follows :—

	1904-5	1903-4	1902-3	1901-2	1900-1
1. United Kingdom	65·2	64·9	66·3	64·5	63·8
2. Austria-Hungary	4·1	2·6	3·2	4·8	4·1
3. Germany	3·9	3·4	2·7	3·7	3·4
4. Belgium	3·6	3·9	3·9	3·7	3·2
5. Straits Settlements ...	3·2	2·9	2·9	2·9	3·0
6. Java	2·1	1·4	0·7	0·5	0·3
7. Mauritius..................	2·1	3·1	2·5	2·4	3·2
8. China........................	2·0	2·3	2·8	2·2	3·3
9. France	1·9	1·9	1·8	1·7	1·4
10. Russia	1·7	2·9	3·4	3·9	3·7
11. Japan	1·2	1·5	1·0	0·87	1·1
12. United States............	1·1	1·5	1·5	1·4	1·6

The above does not include Government stores, of which 94 per cent. in 1904-5 came from the United Kingdom.

The net addition to India's stock of gold in 1904-5, including the local production, was £8,837,431, compared with £8,963,000 in the year preceding. The exports of gold by the Government, amounting to £5,605,000, included remittances to London of £4,500,000 for the purchase of silver, and £1,000,000 for investment in gold securities on behalf of the Gold Reserve Fund. Owing to a mistaken calculation the figures relating to silver imports and exports were overstated in the report for 1903-4. The actual net imports for that year amounted to £9,033,000, which compares with £8,915,000 in 1904-5.—*The Economist.*

NINGPO VARNISH.

The United States Vice-Consul at Hanghchau calls attention to what is known among foreigners in China as "Ningpo varnish," made from the sap of the varnish tree (*Rhus vernicifera* or *Vernix vernicia*) which grows very extensively in western and south-western China. The name was originally given because varnishers from Ningpo were more skilled in its preparation and use than others. The sap is gathered in the interior and brought to Huichoumin, in the southern part of Anhui Province, where it is refined and then distributed to all parts of the Empire. It is sold by the retailer in the raw or pure state—that is, the pure refined sap, and in the prepared form, which is a mixture of the refined sap with certain proportions of "wood oil." It is in the proper blending of these that the skill of the varnisher is shown, as the colour desired, the wood to be varnished, moisture of the atmosphere and temperature are conditions that enter into the problem. The uses of the varnish are manifold. Wherever varnish is desired the Ningpo kind is used, and is so far superior to the ordinary varnish of commerce as to be in a class by itself. It is particularly adapted to floors, tables, cabinets, and such articles as are in constant use. It is also excellent for furniture of all kinds, as it does not scar easily, and may be scrubbed with boiling water without the slightest injury to the very high polish of which it is capable. The greatest drawback to its use is the danger of "lacquer poisoning" to the workmen who use it. This is similar to "ivy poisoning," and when the sap is fresh is regarded as rather dangerous. Once the varnish is dry there is no danger whatever. It may be used in any climate that has a rainy season or wet weather. The varnishing is always done during the wet season and is allowed to dry slowly as the moisture of the atmosphere decreases. The market value of the pure sap after refinement is about 2s. 2d. English money, per catty (catty = 1⅓ pound avoirdupois), while the mixed varnish may be had for about 1s. 1d. per catty. It may be mixed ready for use before shipment and does not deteriorate when once it has been properly blended. Something like a hundred years ago the Ningpoese had a monopoly of the varnish trade, but in some unaccountable manner they lost it to the Huichau firms. Practically all the varnish used at the present time comes from Huichau as its monopoly depends on a knowledge and skill which the Huichau people seem to be able to guard most effectually. The supply of this crude sap would seem to be unlimited, as the trees from which it is derived are found in great abundance in all the middle western and south-western provinces. With proper methods of gathering the sap and of refining, it should, it is said, be made one of the most profitable industries of China.

GUATEMALAN COFFEE.

Shortly after 1860, coffee-growing began to take the place in Guatemala of the cultivation of the indigo and cochineal plants that had been grown there for many years previous to the discovery of the chemical dyes that are now the colours known to the commercial world. From that time until recently, the business gradually grew, until in 1902, the coffee crop exceeded 74 million pounds of clean coffee. Only a small portion of the area of the country is adapted to the cultivation of coffee. At present good Government coffee lands are very scarce, but when found can be had for about 1s. 3d. to 1s. 8d. per acre, and when brought under cultivation with a good stand of trees, are worth from £20 to £100 or more. The coffee of commerce grows in altitudes of 1,000 to 6,000 feet; the best and most prolific trees at 2,000 to 4,000 feet. The labour is cheap, from 1½d. to 10d. a day. The industry as yet has not been brought to a very high

state. Only in a few cases has an effort been made to crowd the coffee trees to see what they could be made to do. Guatemala coffee is rated very highly in the markets of the world, and is the principal industry of the country, it giving employment to more than one-half of the population for about half of the year, during the harvesting time.

GENERAL NOTES.

TRADING RIGHTS IN FRANCE.—In his Report on the Trade, Commerce, and Agriculture of the Consular District of Calais for 1904 (No. 3346, Annual Series), Mr. Consul Payton refers to a very important decision of the French Courts. A British limited liability company, the registered name of which indicated the nature of the business, had for many years manufactured in Boulogne and traded under the British name, usually adding its French translation. A French "Société Anonyme," formed long afterwards, sought to debar the use of the French translated name, pleading that it constituted unfair competition, because customers might be induced to believe that they were dealing with a French company. The Boulogne Court adopted this view, and awarded damages against the British company; but the Court of Appeal at Douai has reversed this judgment, and decided that an alien company, legally trading in France, has full right to make the nature of its business clear to prospective customers by using a French translation concurrently with the name under which it may be registered, but such French name must not be used alone. There are in France many British businesses trading under their French translated name, and if the judgment of the Boulogne Court had not been reversed on appeal it might have seriously affected those firms trading in France in accordance with the Convention of April 30th, 1862, relative to joint stock companies.

HOURS OF LABOUR ABROAD.—It is often complained that the greater latitude in the matter of hours of labour allowed by foreign Governments handicaps British industry. Be that as it may, foreign employers are not always satisfied with the time limits of labour as they affect themselves. For example, the fish curing and fishp reparing industries of Germany complain of the restrictions to which they are subjected, in that they are precluded from employing women beyond the prescribed hours, viz., 8.30 p.m., and 5.30 on Saturdays. Mr. Vice-Consul Oliver reports that although men are allowed to work overtime excepting on Sundays and public holidays, and the local authorities are able to modify these regulations to some extent, it is sought to obtain powers to employ women on a certain number of days in the year after the regulation hours in order that the fish may be dealt with immediately upon its arrival. The present regulations fix the day for women workers at 11 hours, and for Saturdays at 10 hours, but an exception is made in the case of the vegetable preserving industry, and the same privilege is thought to be equally necessary in the fish-curing establishments. The latter claim that they should be able to employ women between the hours of 5 a.m. and 11 p.m. for an 11 hour day, and during 40 days in the year for a 13 hour day.

BRITISH TRADE WITH FORMOSA.—In reviewing the trade of South Formosa for 1904, Mr. Consul Wileman (No. 3490, Annual Series), whose report is dated June 29, 1905, says that there promises to be a good demand for machinery, principally for sugar mills, and the British machinery catalogues might be advantageously re-cast. In many instances these catalogues are issued only for the use of practical engineers, or for persons having a high technical knowledge, and do not compare favourably with American catalogues, which cater for farmers, contain much fuller and simpler details, and are easier of comprehension to the lay mind. It seems desirable that British machinery manufacturers should endeavour to improve their catalogues in a way calculated to remedy this defect, and to adapt them to meet two conditions, firstly for new markets like Formosa, where machinery is but rarely employed, that is to say for districts where the essential points to be considered are moderate prices and simplicity of construction and design, and where too many technicalities are to be deprecated on account of a possible lack of technical knowledge on the part of buyers: and secondly, catalogues for advanced markets, which should contain full technical details of highly-finished or expensive machinery for the use of practical engineers and persons acquainted with the technicalities of machinery. Mr. Wileman thinks that motors will have a good future in Formosa, but only those which are simple and easy of transport. Strong, light carts, with tyres adapted for use in very rough country, will also find a ready sale, provided that samples are actually shown on the spot working in a serviceable manner.

RÉUNION.—The island of Réunion seems to be in a sad case. Last year a cyclone destroyed 50 per cent. of its sugar, and 75 per cent. of its vanilla crops, and another cyclone last March seriously damaged the plantations. Trade with Mauritius has ceased since the outbreak of plague, except for the importation of a certain amount of machinery for sugar mills, and quarantine restrictions have been in force since January. The only share in the commercial life of Réunion, such as it is, possessed by British traders, is the importation of rice from India, and that, together with some rice from Saigon, is carried by about a score of British ships annually. Mr. Consul Maxse (No. 3498, Annual Series) states that if the price of sugar is maintained at its present level, and labour is got for the sugar estates, a little trade with the United Kingdom and British Colonies may spring up, but at present such trade does not exist, and there is no likelihood of its becoming important.

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NOTICES.

EXAMINATIONS.

The Programme for 1906 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The Examinations in Commercial Knowledge are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The Examinations will commence on Monday, April 2, 1906. The last day for receiving entries is February 28th.

Examinations are also held in the Theory and in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian.

PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1906, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

THE EXAMINATIONS OF 1905.

For many years past it has been the practice to include in the Annual Report of the Council a summary of the results of the Society's examinations. But this year the number of candidates has become so large that it was not possible to prepare the usual detailed review of the results at the time when the Council Report was issued. The results, however, have now all been published, and it is possible to examine the effects of the recent changes in the examination system. These changes have been so often set forth in the *Journal*, as well as in the Examination Programme, that it does not appear necessary to describe them again. It may be sufficient to mention that the principal alteration was the substitution of three Stages for two, thus enabling the Council to comply with the suggestions that had often been made to them that an examination of a character somewhat more advanced than hitherto should be provided.

It is satisfactory to be able to report that the changes appear to have met with the approval of all who are interested in the examinations. The best proof of this is the large additional number of candidates, and since the holding of the examinations many expressions of appreciation of the alterations have been received from the representatives of the Local Examination Committees.

The total number of candidates at the examinations held in April last, was 21,253 (Advanced, 4,278; Intermediate, 9,578; Elementary, 7,397). This is an increase of 3,482 upon the 17,771 candidates of 1904. The number of papers worked by these candidates was—Advanced, 4,844; Intermediate, 9,993; Elementary, 8,427. In addition to this there were 540 candidates examined in Music at the same time as those in the Commercial subjects. In addition to these again there were 681 candidates in Colloquial Modern Languages, and 418 in the Practice of Music. The total number of candidates who were examined in all subjects by the Society of Arts during the year ending July last, was therefore 22,352.

Diagram Showing Progress of Examinations, 1883 to 1905.

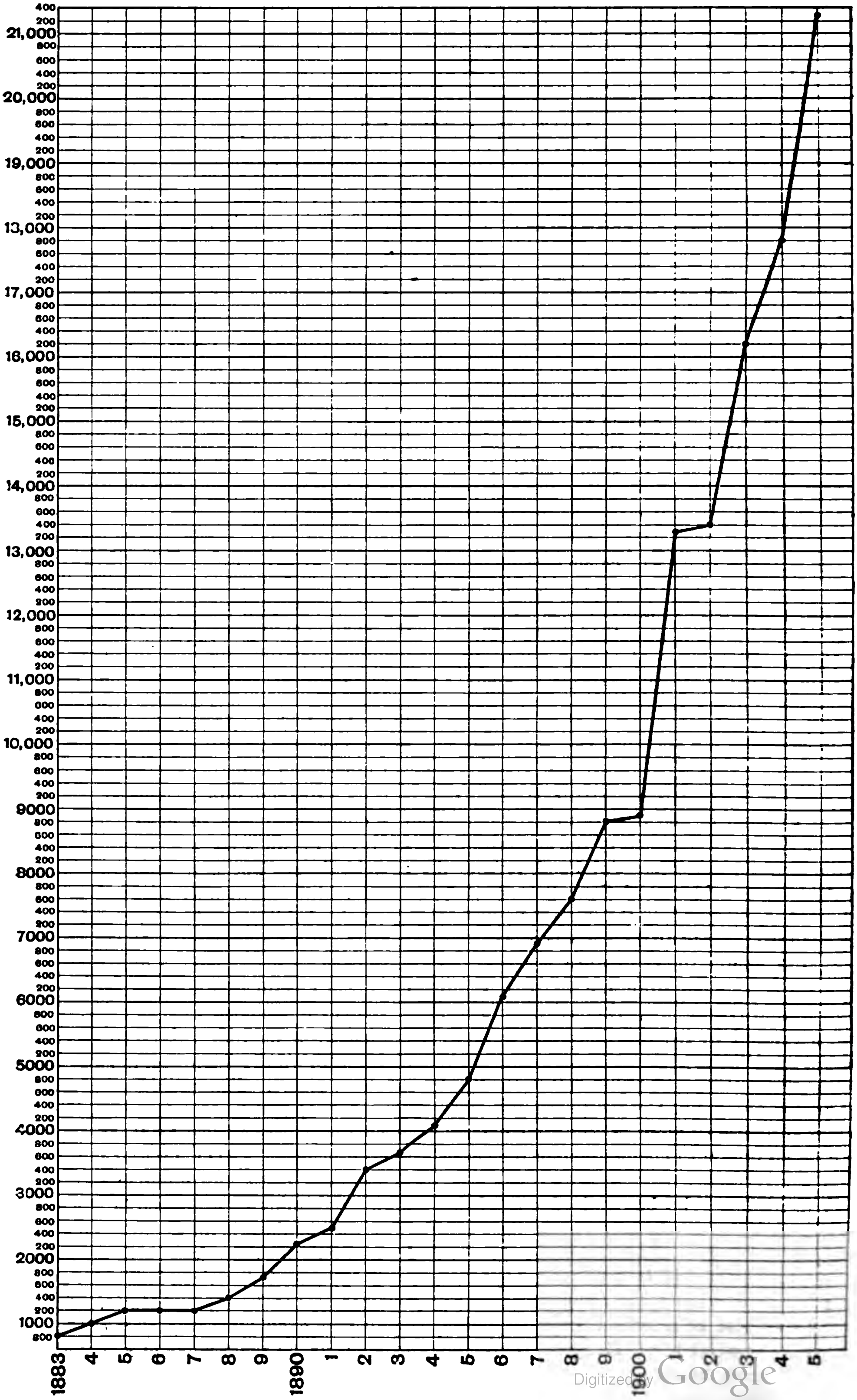

TABLE SHOWING THE DETAILED RESULTS OF THE 1905 EXAMINATIONS HELD AT 383 CENTRES.

Subjects.	Stage III.—Advanced.				Stage II.—Intermediate and Music.							Stage I.—Elementary.		
								Music Certificates.						
	Papers worked.	1st class certificates.	2nd class certificates.	Not passed.	Papers worked.	1st class certificates.	2nd class certificates.	Higher.	Intermediate.	Elementary.	Not passed.	Papers worked.	Passed.	Failed.
Arithmetic	154	49	54	51	360	97	159	..	..	..	104	621	384	237
English	83	6	45	32	235	14	139	..	..	..	82	..	..	..
Book-keeping	1,869	262	1,021	586	3,899	687	2,183	..	..	..	1,029	2,649	1,370	1,279
Commercial History & Geography	48	4	22	22	54	6	30	..	..	..	18	..	..	..
Commercial Geography	..	..	..	..	..	..	..	..	..	..	..	96	63	33
Shorthand	1,010	56	510	444	3,343	539	1,400	..	..	..	1,404	2,230	1,240	990
Typewriting	375	59	188	128	933	115	511	..	..	..	307	1,044	618	426
Economics	48	9	26	13	33	7	20	..	..	..	6	..	..	..
Précis Writing	105	16	36	53	104	21	41	..	..	..	42	..	..	..
Commercial Law	169	15	79	75	..	..	..	..	..	..	..	..	..	..
Accounting and Banking	208	26	121	61	..	..	..	..	..	..	..	..	..	..
French	441	97	219	125	657	124	373	..	..	..	160	851	589	262
German	180	37	76	67	262	70	128	..	..	..	64	315	187	128
Italian	21	10	10	1	12	6	5	..	..	..	1	22	19	3
Spanish	94	13	52	29	80	11	38	..	..	..	31	67	55	12
Portuguese	28	22	6	..	6	2	4	..	..	..	..	..	..	..
Russian	7	2	4	1	10	1	6	..	..	..	3	..	..	..
Hindustani	..	..	..	..	2	..	..	..	..	..	2	..	..	..
Danish	4	4	..	..	..	..	..	..	..	..	..	..	..	..
Japanese	..	..	..	..	3	..	1	..	..	..	2	..	..	..
Handwriting	..	..	..	..	..	..	..	..	..	..	..	532	281	251
Rudiments of Music	..	..	..	..	375	..	..	121	..	173	81	..	..	..
Harmony	..	..	..	..	165	..	..	34	35	53	43	..	..	..
Totals	4,844	687	2,469	1,688	10,533	1,700	5,038	155	35	226	3,379	8,427	4,806	3,621

The general growth of the examinations is shown by the diagram on page 1110. This diagram, which deals with round numbers only, commences with 1883, and ends with the present year. It will be seen that in the 23 years dealt with, the numbers have increased from 800 to 24,000. In the first ten years the increase was moderate, though steady, for the numbers reached 4,600. From that date the growth was rapid, for in five years the numbers had reached 7,600, and in five years more this number had been more than doubled—16,200. It may be mentioned that these totals include the results of the written examinations in Music, but not those of the *vivâ voce* examinations or of that in the Practice of Music.

The detailed results of the 1905 examinations, which were held at 383 centres, are shown by the table on page 1111. This table shows the number of papers worked in each subject in each Stage, and the number of successes and failures. Exact comparison with the work of previous years is precluded by the alteration in the system. It may, however, be noted that the total number of candidates in the Advanced and Intermediate Stages show in every subject, except Italian and Spanish, an increase on the numbers entering for the corresponding subjects in Grade II last year. In Spanish the numbers are the same—174. In Italian there were this year 33 candidates, whereas last year there were 38. This trifling deficiency is more than accounted for by the fact that Italian has been added as a subject in the Elementary Stage and that there were 22 entries for it. In some subjects the increase is very slight—Commercial History and Geography, 102 against 98; Economics, 81 and 79. But in others the increase is very large. Book-keeping is still, as always, the most popular subject, and heads the list with 5,768, against 4,893 last year. Shorthand comes next with 4,353, compared with 3 910; then Typewriting, 1,308 and 1,044. Précis-writing has almost doubled its numbers—209 and 106; and Arithmetic shows a satisfactory increase—514 against 345. The same may be said of English with 318 against 258. All the modern languages (except the two previously mentioned), show an increase—French, naturally the largest, 1,098 compared with 805; while German follows with 442 against 318. Spanish comes next with 174 in both years, while the numbers of the other languages are naturally smaller, with a small proportionate increase—Portuguese 34 and 29, Russian 17 and 11, Danish 4 and 2. Italian alone, as above stated, shows a falling off, 33, compared with 38. It is satisfactory to note that of the additional subjects added this year, two attracted a substantial number of candidates—Commercial Law 169, and Accounting and Banking [illegible] Hindustani, which was also added this year, only attracted two candidates. It is hoped that this may be improved in future years. Japanese has been on the list for a long time, but this was the first year in which an examination was held, three candidates having entered for it.

PERCENTAGES OF SUCCESSES AND FAILURES. ADVANCED STAGE.

	First-class.	Second-class.	Failures.
Arithmetic	31·82	35·06	33·12
English	7·23	54·22	38·55
Book-keeping	14·02	54 63	31·35
Commercial History and Geography	8 33	45·83	45·84
Shorthand	5·50	50·50	44·00
Typewriting	16·00	50·00	34·00
Economics	19·00	54·00	27·00
Précis-writing	15 20	34·30	50·50
Commercial Law	9·00	46·60	44·40
Accounting and Banking	12·50	58 17	29·33
French	21·70	50·00	28·[illegible]
German	20·50	42·20	37·30
Italian	47·60	47·60	4·80
Spanish	13·75	55·50	30·75
Portuguese	78 50	21·50	0·00
Russian	28·60	57·10	14·30
Danish	100·00	0·00	0·00

PERCENTAGES OF SUCCESSES AND FAILURES. INTERMEDIATE STAGE.

	First-class.	Second-class.	Failures.
Arithmetic	27·00	44·00	29·00
English	5·90	60·00	34·10
Book-keeping	17·62	55·99	26·39
Commercial History and Geography	11·11	55·55	33·34
Shorthand	16·10	41·90	42·00
Typewriting	12·32	55·00	32·68
Economics	21·21	60·65	18·14
Précis-writing	20·20	39·42	40·38
French	18·87	56·78	24·35
German	26·72	48·24	24·44
Italian	50·00	41·70	8·30
Spanish	13·75	47·50	38·75
Portuguese	33·40	66·60	0·00
Russian	10·00	60·00	30·00
Hindustani	50·00	0·00	50·00
Japanese	0·00	33·40	66·00

The manner in which the various subjects were dealt with may be estimated from the preceding tables which show the percentages of failures and successes in the two upper stages. The number of entries in some of the smaller subjects is insufficient for such calculations to have much value, but the percentages are given for the sake of completeness.

In the Elementary Grade the 7,397 candidates worked 8,427 papers, so that a large proportion of the candidates in this, as in the higher grades, were content with a single subject. Book-keeping attracted the largest number, 2,649, and there was an increase of 364 on the 2,285 of last year. The subject, however, showing the greatest increase was Shorthand, for there were 411 more than in 1904, 2,230, against 1,819. The next largest subject was Typewriting, for which 1,044 candidates presented themselves in 1905, and 914 in 1904. In Handwriting and Correspondence there were 532 this year, and 371 last; in Arithmetic 621 and 577. In French the numbers were 851 and 828, in German 315 and 252 (a good proportionate increase), Spanish 67 and 25 (the largest proportionate increase of any). In Commercial Geography alone was there a falling off, for only 96 candidates entered, whereas last year there were 132. Italian, a new subject in the Elementary Stage, attracted 22 entries.

The general percentages of success and failure work out as follows: — Advanced, First-class, 14·2; Second-class, 51; failures, 34·8. Intermediate, First-class, 17; Second-class, 50·4; failures, 32·6. Elementary, successes, 57; failures, 43. With regard to Stages III. and II., these percentages may be looked upon as about normal. Last year, when there were three classes, the percentages were:—First, 13·4; Second, 28·7; Third, 33·9; failures, 24. It is evident that in both stages a few of the old Second-class have been admitted into the First, while the bulk of the Third have passed into the new Second, the remainder having dropped down among the failures. This is very much what might have been expected, and shows that the standard aimed at has been successfully attained by the Examiners. It appears certain that a good many of the candidates who attempted the Advanced Stage were a little too ambitious, and would more wisely have been satisfied with the Intermediate. The advice may safely be repeated, that candidates entering these examinations for the first time should content themselves with Stage II., unless they are advised by competent authorities that they are sure to succeed in Stage III. A First-class in Stage II., followed by a First-class in Stage III., is a far more valuable record than a Second-class in Stage III., though it be obtained the first time of asking. In future years a slight elevation of the Advanced Stage may fairly be looked for, but no attempt to raise it will be made next year. It is not to be expected that any change of standard will be made in the Intermediate Stage.

As regards the Elementary Examinations, a comparison with the work of previous years is possible, because in this Stage no alteration has been made. The percentage of successes (57 to 43) compares rather unfavourably with last year, when 61 per cent. passed and 39 failed. It is quite evident that the increase of numbers from 7,203 in 1904 to 8,427 in the present year has been accompanied by a slight falling off in the qualifications of the candidates, a proportion of whom certainly enter without such training as justifies them in expecting to pass even an examination of such a very simple character as the Elementary. That this is the case is evident from the fact that the proportion of failures shows an increase in nearly all the subjects, except French, in which the standard was designedly lowered, and in Spanish, in which the numbers are hardly large enough to form a basis for generalisation. It is, however, not so much to the language subjects that the above remark applies, as to those of a more purely commercial character.

It will therefore be well if teachers will exercise some discrimination in recommending candidates to enter. It is very unsatisfactory to all concerned to have to reject such a large proportion of candidates. On the other hand it must be remembered that even to the unsuccessful the examinations may have served a useful purpose as a stimulus to study. They must not therefore allow their failure to be a source of discouragement, but rather regard it as an indication of the weak points by remedying which they may be encouraged to study and to do better another year.

We may now turn to the manner in which the various subjects were dealt with, and the comments upon them of the examiners.

The examiner in Arithmetic thinks that the advantage of the division of the whole examination into three Stages has been confirmed. The inclusion in one list of

those who only desired an Intermediate certificate, and those who were striving to pass the Advanced test, caused the percentage of successes to appear low. Now the intention of the candidates finds its expression in the choice between the second and third Stages, with the result that the percentage of First-class passes in both Stages in higher than before. On the whole, the standard in Arithmetic seems to have risen a little. In the Advanced Stage the candidates seem, in many cases, to have shown a lack of knowledge of the use of logarithms, which is included in the syllabus; and in the Intermediate Stage the common fault occurs of taking a particular case when it is required to prove a general statement, thus affording an illustration, but no proof. The candidates in the Elementary Stage have done better than in any previous year.

In his comments on the English papers, the examiner remarks, with reference to the Advanced Stage, that few candidates obtained a high total of marks, but that, on the whole, the paper was dealt with in a satisfactory manner. The questions on syntax were treated in an intelligent manner, but the section on historical grammar was less satisfactory. Some of the essays were excellent, and though the paraphrasing was in great part superficial, some excellent epitomes were given. The answers on the history of literature showed a fair acquaintance with the titles of books and the names of authors, but not much familiarity with the works themselves. In the Intermediate Stage also some of the essays were extremely good, and so were some of the business letters. The section on grammar was not well answered, but the composition section was better done.

The Book-keeping examinations show the largest increase of any year. The examiner, by means of a table in which he has calculated what this year's results would have been, had the old standards been followed, so as to form a general idea of the relative merits of the candidates between this and the previous years, finds that while there would have been a slight falling off under the old *régime*, the standard of merit has been considerably raised, with a corresponding increase of failures. The answers to the special questions in Stage II., were, upon the whole, poor and disappointing, but the working of the exercises was rather better than usual. There is, however, still plenty of room for improvement in form and neatness, and also in arithmetical accuracy. On the whole, the training of the candidates appears to have been careful and practical; but it is evident that in some of the centres the teaching available leaves much to be desired. This is evident from the fact that the bad papers come in batches apparently from the same centre. The papers in the Advanced Stage showed fair average merit, but a good deal of carelessness in arithmetical work. The First-class generally, and especially those who have obtained the highest places, showed considerable knowledge of the subject.

In the Elementary Stage, the result, as a whole, is not so satisfactory as in the past two years, the percentage of the really good papers is a trifle less, that of really poor papers nearly twice as great as in 1903 and 1904, though better than in 1902; while the medium papers getting from 30 to 69 per cent. marks (20 per cent. above and 29 per cent. below the dividing line)—apart from actually passing or failing, is a little below that of 1903 and 1904.

"It is, perhaps, useful for the most ignorant to get some idea of what an examination means and to get accustomed to its methods, but apart from that consideration, I should say that more than 100 candidates were totally unprepared, and ought not to have entered for the examination. Of course, such tend to swell the percentage of what one might call legitimate failures."

The following are the examiner's remarks on the papers worked in the Advanced Stage of Commercial History and Geography:—

"Some excellent work was received from a few of the candidates, but the proportion of failures was large, nearly 46 per cent. of the total. This is no doubt largely due to the fact that the examination is a new one, and many of the candidates apparently have not realised the standard that must be reached in order to maintain a true distinction between the Intermediate and Advanced Stages. Too many of the answers betrayed an insufficient study of maps, so as to ascertain among other things how physical features influence, and in some cases, control the relations of towns to one another with respect to the means of communication. In answer to the question about the trans-Alpine connections of present and past times, one candidate said the difference between now and the Middle Ages was "that between railway tunnels and mountain passes, and direct railway routes and winding valley roads." A proper study of the map would have shown him just how much, and at the same time how little truth there is in this observation. Many of the candidates gave very indefinite answers to the question on the influence of water power in localising industries, including bleaching and dyeing among the industries under this head. In answer to the question about the mediæval spice trade many wasted time and space in describing

the routes by which the spices were brought to Venice and Genoa, which was not asked. About one-sixth of the candidates added to the value of their answers by really good sketch-maps, but a large number of the sketch-maps were of little or no value as not being illustrative. Sketch-maps which give no additional precision or clearness to answers but merely vaguely repeat what is already stated in the text earn no marks."

As to the Intermediate Stage, he says:—

"As this is the first year in which the higher examination was divided into two, no comparison can be made with last year as regards the number of candidates, but as the new Intermediate Examination is in a large measure on the same lines as the higher grade examination of last year, a comparison may be made with respect to the features of the candidates' work. The amount of attention given to the general questions in the paper may again be noted with satisfaction, and, on the other hand, it has again to be recorded that the questions relating to commercial history were those to which the answers were generally less satisfactory. Little was known of the history of the British trade in raw cotton, or of the commercial history of Antwerp, Bremen, and Rotterdam, and the relation of that history to changes in geographical conditions. The question as to Venice and Genoa, however, was much better answered. The question most avoided, and most inadequately answered when attempted, was that on the German coal trade. This is significant. It betrays a deficiency in geographical analysis. One aim in setting a special subject including only parts of certain countries, was to show the necessity for such analysis. The answers, not merely to that question but also to others, made it plain that the candidates thought of each country as carrying on trade with other countries; as if they were all separate units, not realising the fact that the external trade of different countries is merely the aggregate result of a great number of individual and local needs. If a German manufacturer wants coal, and knows he can get what he wants most cheaply just across the border, it does not occur to him to consider that remote parts of Germany may be remarkably well supplied with coal; and similarly, a German coal-master does not seek to supply distant German customers when he can find more profitable customers nearer at hand, or more accessible if not nearer, though on the other side of a frontier. Among other prevalent misconceptions, may be noted the idea that trade is of little or no account unless it is external, above all export trade; that coal and iron ore are generally found together; and a most exaggerated conception of the importance of inland waterways. The navigability of the Thames to Lechlade was again and again referred to as a matter of importance in relation to the leading features of the trade of London. It was disappointing to find, again and again, in papers of this stage, places stated to be in a 'good position' for trade. Candidates ought to understand that such statements are of no value. What is required in such cases is a statement of the geographical circumstances, that is, the local conditions and place relations, that make a position 'good' for trade. The majority of candidates furnished no sketch-maps, good or bad, and thereby lost marks."

With regard to the Elementary Stage, he says:—

"The number of candidates this year showed a decline of more than 30 per cent. on the number of last year, but the standard of preparation was for the most part much more satisfactory. The candidates fell naturally into groups, in some of which the state of preparation left little to be desired, while in others it was quite the reverse. In more than one of the better groups the chief defect that remained to be remedied was the lack of the power of broad geographical description. In those groups the most defective answers were those to the first question, which asked primarily for a description illustrated by a sketch-map of one out of three counties, each of which has well-marked distinctive features, and secondarily for some particulars with regard to the chief town of the county described. The following may be taken as a typical answer from one of the groups referred to, an answer, it should be mentioned, taken from a paper which was on the whole a very good one, indicating decided intelligence:—'Aberdeen manufactures woollen goods, carpets, machinery of many kinds, notepaper and envelopes, chemicals, and has the largest comb factory in the world.' Now, even if all that is true, these burdensome details are uninstructive, uneducational, and non-geographical, and the enumeration of them does not make up for the entire absence of description, for the omission of any mention or indication of the Grampians, and for the defects of a sketch-map which showed nothing but an indifferent outline and the direction of the Dee. Such answers indicate too great dependence on text-books and books of reference. The remedy is to cultivate the habit of learning as much geography as possible directly from the map, and setting forth what is learnt in significant sketch-maps, however rough these may be."

As to Shorthand, the examiner considers that the work on the whole was good, though many candidates failed to obtain the Advanced standard who might have successfully tried for the Intermediate. As to the Intermediate Stage he says:—

"A month or two devoted to speed practice should enable most of those who failed in this stage to take a high place in the next examination, the failures being due less to want of acquaintance with the system than to lack of training in writing quickly from dictation. Many students over-estimate their attainments, as far as speed of writing goes, or are

prematurely sent up for examination by their teachers in the hope that they may struggle through and add another pass to the credit of the school. 'Hasten slowly' is a golden rule for the shorthand student."

As regards the Elementary Stage, looking upon it entirely as an elementary test for students who have not finished their studies, he considers that the general result is highly satisfactory.

The examiner in Typewriting says:—

"I have never examined a better set of papers than those of the candidates who submitted themselves for the senior test. The explanation of this excellent result is to be found in the fact that numerous holders of the Society's medals and First-class certificates awarded for Typewriting in previous years under the late examination scheme came forward as contestants for the more valuable medals, prizes, and certificates offered in the new Senior Stage. The majority of the papers bore unmistakeable evidences of sound and careful training supplemented by actual business experience. The number of failures is attributable not so much to lack of knowledge as to incapacity to write beyond a very low speed—a senior candidate should be capable of operating at an average speed of 40 words per minute."

As to the Intermediate Stage, he says:—

"The quality of the work submitted may be considered satisfactory, but not so the quantity. Until more adequate facilities are afforded students for practice in the acquirement of manipulative dexterity, no substantial increase in the First-class passes can be looked for. An average speed of 30 words per minute is expected in this stage. I advise that more attention be given to the drafting of simple, clear, and concise answers to theoretical questions dealing with typewriting and office work allied thereto, and those appliances employed as auxiliaries to the writing machine. Such training might form matter for home study, and certainly would prove of real value, especially if the students' exercises are carefully scrutinised and the weak points noted and made material for further study. The answers to the theory questions submitted by too many candidates give evidence of want of training in thinking, the *sine quâ non* of successful teaching. Attention is also directed to the fact that candidates were in many instances hampered with defective machines, or machines fitted with exhausted ribbons or pads."

In both cases many candidates showed a good deal of carelessness, and the examiner quotes a number of blunders, which, though many of them are amusing, show a sad lack of common sense on the part of the candidates. As to the Elementary Stage he thinks:—

"The introduction of the Theory Paper, and the more searching test imposed, has led to a perceptible decrease in the number of passes. This year's figures, however, compare favourably with those of 1903. Now that the character of the test is common knowledge, an improvement may be anticipated next year. There are indications that typewriting class-rooms will be better equipped than heretofore, more particularly in reference to appliances for imparting instruction in office procedure as allied to typewriting. I recommend that more time be devoted to reading from manuscripts, and that students be trained to observe also that theory questions covering the examination syllabus be given as home study. Such a method of procedure is the only way of preventing a repetition of such ignorance as was displayed in the answers to the questions given this year."

In Economics the examiner reports that the number of candidates in the Advanced and Intermediate Stages showed a slight increase on the number in the one grade in the previous year. In the Advanced Stage the general level of work was good; in the Intermediate it was not so satisfactory. Candidates would do well to consider carefully the meaning of each question before they attempt to answer it; otherwise their answers are apt to be entirely off the point. More attention needs to be paid to economic history.

The examiner in Précis-writing thinks that the large proportion of failures is chiefly due to many candidates having entered for the Advanced Stage who would probably have been better advised if they had entered for the Intermediate Stage. The work done by the candidates who obtain First-class certificates on this occasion was very good.

In the Intermediate Stage he remarks that indifferent handwriting and want of neatness contributed to many of the failures, but most of them seem to be principally due to lack of experience and inability to grasp the relative importance of statements.

The examiner in Commercial Law considers that:—

"The quality of the papers was, as might be expected, extremely uneven; while some of the best papers were altogether creditable to their authors, there were, at the other end of the scale, papers exhibiting defects which ought not to be found in the work of candidates in a legal subject: such as atrocious misspelling, *e.g.*, 'Gazzit' for 'Gazette,' and in many cases minor inaccuracies in spelling which reflect no credit on the care of the candidate for accuracy; mistranslations of the maxim, *caveat emptor*, were rife, *e.g.*, 'Let the buyer be aware,' and 'No one can give that which he has not got,' which showed that the candidate had not seriously considered the meaning at all.

"Where there is no Third-class there must usually be some failures, but, taken as a whole, the papers

reached a fair average; although there is frequently a considerable disparity between those who just scraped through and those who just failed to get a First-class; this is inevitable."

In Accounting and Banking the examiner notes that as this is the first year of examination in this subject, there can, of course, be no comparison with previous records. On the whole, the knowledge shown by the candidates was fair, and, though 61 failed to obtain a place there were few utterly bad papers, while many of the papers placed in the First-class (though the percentage of First-class is small) evidenced considerable knowledge and ability.

Coming now to the modern language subjects, the French examiner says that in the Advanced Stage:—

"The general results were good. Several sets of answers were remarkably well done throughout. Though an extensive knowledge of commercial French was shown by a fair proportion of the candidates, this part of the work was not so good in general as might be desired. Many of the essays written by students aiming at a First-class certificate were sensible, and expressed in good French; few could be deemed weak. The number of ill-prepared students was rather large. Many of those who presented themselves for examination in this Stage, should have entered for the Intermediate Stage."

Of the Intermediate Stage, he remarks that:—

"The work on the whole was highly satisfactory. In many instances, the exercises were of an exceptionally high order of merit. The translation from French into English was generally good, and that from English into French fairly so. A good knowledge of commercial French was shown by a considerable proportion of the candidates. As a rule, the grammatical questions were well handled, but rather too many defective answers were given to the questions on adjectives and verbs. The number of rejections was not very large, and that of absolute failures was small."

The paper in the Elementary Stage was, as before remarked, a little easier than that of last year, and the number of failures was consequently less.

"The translation from French into English was generally good; though that from English into French was not equally commendable. In dealing with the commercial letters, too many candidates gave literal renderings. More attention to commercial phraseology is desirable. In most cases the grammatical questions were well answered, but the question on the use of pronouns did not often receive adequate treatment. The idiomatic and commercial phrases were very well translated by a few candidates, but this portion of the work left much to be desired. The general results were good, and indicated careful teaching and intelligent study."

The examiner in German remarks on the Advanced Stage that—

"The papers were very unequal in quality. The best were really brilliant efforts, but a large proportion, even of the better papers, contained mistakes in elementary grammar rules, such as inversion, government of cases by prepositions, &c. Many candidates read the questions carelessly, and so made mistakes which they might easily have avoided. At least ten of the candidates showed more courage than discretion in attempting an Advanced paper. On the other hand eight candidates obtained over 90 per cent. of the marks. More attention should be paid to style, both in English and in German. Expressions like 'did not ought' were abundant, and split infinitives enjoyed an enviable popularity. Some candidates have original views on spelling and punctuation."

In the Intermediate Stage, he says that—

"The papers on the whole were satisfactory. Few rose above mediocrity, but only a small percentage were quite devoid of merit. The translation into German was the chief stumbling block. Ignorance of particular words is a small matter, but ignorance of the use of cases and the conjugation of verbs is a bar to success in any examination, however elementary. It must be remembered that without grammar it is impossible to write German or any other kind of prose. Candidates who coin forms like *liebtest*, *müsst*, &c., who are unaware that datives plural end in —*n*, and who show no respect for the three concords, are ill-advised to sit for examination. It is also useful to remember that a translation which is unintelligible cannot be right, and that even Chinamen do not usually journey 'by *boot* on a canal,' or receive Europeans 'yapping with outstretched mouths.' Much carelessness was shown in the transcription of words: Veitel Itzig appeared some scores of times as Beitel Issig, and Shanghai and Macao underwent strange metamorphoses. The same superficiality accounts for some curious renderings of *Missionare* and *Assecurateur*, who are repeatedly identified with millionaires and monkey-owners. Similarly, a confusion of *Binnen* and *Bienen* makes *Binnenhandel* into apiaries. It is not necessary, as some candidates have done, to write the English translation in German script. The effect is more quaint than pleasing."

Of the Elementary, he remarks that:—

"The translation both into German and into English was, on the whole, intelligently done. But there was a striking weakness in grammar, due, perhaps, to excessive devotion to conversational methods. Some candidates seemed to be unacquainted with the terminology of grammar, or they could hardly have confused declension with comparison, propositions with conjunctions, simple with compound tenses. If the principles of word formation

were better understood, many candidates who failed in translation might have recognised familiar roots under a thin disguise: a small vocabulary, judiciously used, will go a long way. Some failures were probably due less to sheer ignorance than to inability to make use of knowledge actually possessed. There were some excellent specimens of German script."

In Italian, on the whole, the greater number of papers showed a thorough study of the subject, and many candidates in the Advanced Stage showed a good knowledge of commercial language.

In Spanish, the examination was satisfactory, and here again the majority of the candidates on the Advanced Stage showed a good knowledge of commercial technicalities.

The Portuguese examiner was generally well satisfied with the work, and thought that the Advanced candidates were well up to the standard.

In Russian and Danish the number of candidates were very few, but the work on the whole showed promise.

In Hindustani no candidates entered for the Advanced Stage. As to those who entered for the Intermediate Stage, the examiner remarks:—

"Candidates must not rely solely upon an ordinary colloquial knowledge of Hindustani, but should endeavour to become more thoroughly acquainted with the language by carefully studying its grammar, and by learning to write the native characters with ease and accuracy. They should also acquire a knowledge of idiomatic phrases, and of the more polished style of composition; and, for this purpose, they should read some of the text-books usually prescribed for examinations at home and abroad."

In Japanese also, there were no candidates in the Advanced Stage, and though the paper was of set purpose made extremely easy, the work of the candidates was not very satisfactory. It is evident that the students had not learned the Japanese alphabet (Kana), and the examiner remarks that to master the Japanese language it is essential for the students to learn it by the Kana, which consists of only 46 phonetic signs. If any one learns the Japanese by Roman character, he will never acquire the real pronunciation, as all foreigners have a tendency to read and to pronounce it according to the phonetic spelling of their own language.

The results in Handwriting and Correspondence (Stage I.) were the best since the examination was started in 1901, and compare favourably with last year's results.

Theory of Music.

These examinations are divided into two subjects, Rudiments of Music, and Harmony. In the former subject, an Elementary and a Higher certificate is given; in the latter, there is also an Intermediate certificate.

The papers were as usual sent out with those for the Intermediate Grade of the Commercial Knowledge examinations, and the examinations were conducted under precisely the same conditions.

The examiner reports that for the Elementary certificate in Rudiments of Music, there were 225 papers; 173 passed and 52 failed. Nine papers gained full marks, and 99 gained at least 90 per cent. of the maximum number. The failures were owing mainly to want of knowledge of intervals, and of how to transpose.

For the Higher certificate, there were 150 papers; 121 passed and 29 failed. Five gained full marks, and 56 gained at least 90 per cent. of the maximum. On the whole the result was very satisfactory. The weakest points were in the analysis of keys, transposition, and the transcription of twelve-eight to four-four time.

For the Elementary certificate in Harmony, of the 64 papers received 53 passed, 11 failed, 7 gained full marks, and 34 gained 90 per cent. or over. The ungrammatical part writing in the "filling-in" exercises was the chief cause of failure.

Of the 51 papers received for the Intermediate certificates 35 passed, 16 failed, none gained full marks, and 6 gained 90 per cent. or over. It seems that this recently established grade is likely to be a useful stepping stone to the Higher certificate. Weakness was sometimes displayed in the harmonization of the cadential phrases submitted. Students at this stage should learn by heart the common approaches to well known cadences such as those given in the question.

Of the 50 papers received for the Higher certificate 34 passed, 16 failed, none gained full marks, and 13 gained 90 per cent. or over. Almost all the failures were owing to the ineptness of the harmonization of the melodies given. It is safe to say that some candidates would be much shocked on hearing the "harmony" they wrote. Really good harmony

cannot be devised unless the mind can conceive the effect of what is written. Ear training in chords and harmonic progression is the only rational path to success.

Practice of Music.

The practical examinations in Music were held this year from June 19 to July 5, eleven days in all.

In all, 437 candidates entered, and of these 418 were examined, a decrease of 138 as compared with last year. There were 319 passes and 99 failures.

The following were the subjects taken up :—Piano, singing, violin, violoncello, viola, and clarinet. 343 entered for the piano, 257 of whom passed; 55 entered for the violin, of whom 47 passed; 3 entered for the violoncello, all of whom passed; 14 entered for singing, of whom 9 passed; 2 entered and passed for the viola, and one for the clarinet. No medals were awarded.

The examiners reported that the chief causes of failure to secure a certificate were owing to the non-observance of good touch and tone, exaggerated accent, or inability to perform the music at the recognised pace. There were also some cases where the candidate showed inadequate knowledge of the minor scales, whilst others were quite unprepared with them. In several respects, indeed, there was evidence of want of care in reading the printed conditions.

Viva Voce Examinations in Modern Languages.

During the present year 23 examinations have been held in London, Manchester, and Bristol.

At these examinations, 681 candidates presented themselves, of whom 502 passed (83 with distinction) and 179 failed. The languages taken up were French, German, Spanish, Portuguese and Italian. The last named language was added this year to the list.

The results of previous years are as follows :—

Year.	Number Examined.	Passed.	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165

The following is a complete list of the *Vivâ Voce* Examinations held during 1905 :—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French :—					
Crouch-end Council School	March 29.	40	5	28	7
Willesden Polytechnic	March 30.	22	3	11	8
Acton and Chiswick Polytechnic	March 31.	31	2	21	8
Manchester Education Committee	May 16.	21	4	11	6
Birkbeck College (Candidates from London Polytechnics)	May 30 & 31.	69	6	51	12
Battersea Polytechnic (Candidates from London Polytechnics)	June 1.	33	4	18	11
L.C.C. Evening School, Sussex-road, Brixton	June 14.	30	2	23	5
L.C.C. Evening School, Queen's-road, Dalston	June 15.	23	2	16	5
L.C.C. Evening School, Choumert-road, Peckham	June 16.	26	1	20	5
L.C.C. Evening School, Tottenham rd., Kingsland	June 17.	23	6	13	4
L.C.C. Evening School, Plough-road, Clapham Junction	June 19.	25	—	19	6
L.C.C. Evening School, Offord-road, Barnsbury	June 28 & 29.	61	4	47	10
L.C.C. Evening School, Queen's-road, Dalston	July 10.	14	3	10	1
Merchant Venturers' Technical College, Bristol	July 11 & 12.	84	2	45	37
German :—					
Manchester Education Committee	May 19.	9	4	5	—
City of London College (Candidates from London Polytechnics)	May 31.	36	6	19	11
L.C.C. Evening School, Offord road, Barnsbury	June 29.	25	6	11	8
L.C.C. Evening School, Queen's-road, Dalston	July 6.	22	9	7	6
Merchant Venturers' Technical College, Bristol	July 13.	41	5	20	16
Spanish :—					
Manchester Education Committee	May 17.	18	3	8	7
"Hugh Myddelton," L.C.C. School, Clerkenwell	July 11.	19	4	10	5
Portuguese :—					
Manchester Education Committee	May 15.	5	—	4	1
Italian :—					
"Hugh Myddelton" L.C.C. School, Clerkenwell	July 12.	4	2	2	—
		681	83	419	179

The following are the examiners' reports for French, German, and Spanish :—

French.—"502 candidates were examined. Of these 44 passed with distinction, 333 passed, and 125 failed. The number of candidates examined was larger than in any previous year. In reading, the improvement was particularly marked; in very few cases did the candidates read badly. In nearly every

centre there were some dictation exercises which were practically faultless and a few were perfect. In several cases, however, candidates who conversed with tolerable fluency did not send up good exercises in dictation. The mark of distinction was earned by a fair proportion of the candidates, and the majority conversed readily and sensibly on topics of general interest. The students exhibited much keenness and enthusiasm. The general results were good and tended to show that the training had been sound and thorough."

German.—"133 candidates were examined. Of these 30 passed with distinction, 62 passed, and 41 failed. The results of the examinations show an all-round improvement on those of last year. A larger number of candidates was examined, and the percentage both of passes and distinctions was considerably higher. The dictations were on the whole much better than in previous years, yet there were still a few cases of candidates with a good knowledge of the language and considerable power of expression who were unable to write a passage of German without making many elementary mistakes in orthography. Yet taken altogether the results were very good, and testified to the thoroughly efficient and practical nature of the German teaching in the institutions concerned, while forming at the same time another refutation of the once-held theory of English inability to learn to speak foreign languages."

Spanish.—"I am pleased to be able to report very favourably on the result of the Spanish *vivâ-voce* examination. The reading of a Spanish passage was generally satisfactory. Several exercises in dictation were fautless. The great majority of the candidates understood fluent speech and could express themselves fluently and correctly on the various topics discussed. Out of the 37 candidates who presented themselves for the examination 25 have passed, 7 with distinction; the conversational knowledge of the latter was remarkably good. On the whole the result of the examinations is most encouraging."

EXAMINATIONS, 1906.

With regard to the Examinations for 1906, very little change in the Programme is proposed. The only alteration of any importance is in Shorthand. Formerly all the different stages of Shorthand were taken on the same evening. The different stages will now be taken on two evenings: Advanced (First-class 150, Second-class 120 words per minute), and Elementary (50 words) on one evening; Intermediate (First-class 100, Second-class 80 words) on another.

The alterations originally proposed have been considerably modified in view of the opinions expressed by the various local Committees, and their executive officials, to whom they were submitted. It is hoped that the system now adopted may meet the requirements of the majority of the candidates.

Swedish has been added to the list of subjects in the Advanced and Intermediate Stages, and the examination in Danish will in future be in Danish and Norwegian.

All the other subjects will be the same as last year. It may be hoped that a larger number of candidates may be attracted to the subjects of Japanese and Hindustani, and perhaps some may be induced to enter for Chinese, a subject which has been in the Programme for a good many years without attracting any entries.

It may be well to point out that though the classification of the Examinations was modified last year, its character remain unaltered. The papers now set are of the same character as those of the previous years, which will therefore, as hitherto, form a useful guide to the nature and scope of the Examinations.

INDIAN RAILWAYS IN 1904.*

This annual report contains information of general interest to the community, in addition to its minutely detailed returns of the nature of the traffic carried by, and items of expenditure incurred on, various Indian railway systems. Some interesting particulars are afforded respecting the Indian coal industry during 1904, when the total output from the collieries in India and Burma amounted to 8·23 million tons against 7·44 million tons in 1903. The exports of Indian coal to Indian ports, principally Calcutta to Bombay, Karachi, and Madras, rose from 1·24 million tons to 1·45 million tons, or by 210,000 tons, and those to ports outside India including Burma from 273·87 thousand tons to 896·81 thousand tons, or by 173·01 thousand tons, principally to Rangoon and Ceylon. The imports of coal from the United Kingdom rose from 133·71 thousand tons to 174·71 thousand tons, or by 41,000 tons, and those from other countries, from 30·43 thousand tons to 79·17 thousand tons, or by 48·74 thousand tons. This was probably due to the fall in value of coal in England and low freights.

The total quantity of Indian coal consumed by railways during the year 1904 increased, from 2·20 million tons to 2·45 million tons, or by 250,000 tons, while the amount of foreign coal consumed fell from 17·70 thousand tons to 17·43 thousand tons. The improvement in the traffic in coal carried by railways was due principally to the increase of 604·49 thousand tons and Rs. 20·34 lakhs recorded by the East Indian Railway, owing to larger despatches from colliery stations for foreign railways and for export. On the Bengal-Nagpur Railway the quantity

* Administration Report on the Railways in India. (Cd. 2619.) Wyman and Sons, Fetter-lane, E.C. Price 3s.

carried increased by 106·25 thousand tons, but the earnings were less by Rs. 1·12 lakhs.

Except in regard to cotton, the crops of which were adversely affected by unseasonable rains, there were general increases in the amount of agricultural produce carried. There was a large increase of 1·18 million tons and Rs. 123·77 lakhs in the wheat traffic included under "grain and pulse," which is chiefly attributed to good crops and to an increase in the export demand. A brisk export trade in linseed and rape and mustard seeds increased the traffic under "oil-seeds" by 165,000 tons and Rs. 16·62 lakhs. Under "grain and pulse," rice in the husk also showed an increase of 225,000 tons and Rs. 11·32 lakhs, consequent on a bumper harvest in Burma and a brisk movement of the commodity to Bombay.

From the broad standpoint of financial success, the result of the working of State and Guaranteed railways for the year 1904 was a net gain to the State of 263·22 lakhs of rupees, the largest yet obtained in any year, after meeting, in addition to the expenses of working, all charges for interest on capital outlay by the State and on capital raised by companies, and also the annuity payments for railways purchased by the State, including both interest and the portion that represents redemption of capital. This is the fifth year in succession in which there has been a surplus. After excluding the portion of the annuity, payments representing redemption of capital, Rs. 95·02 lakhs, the surplus to the State for the year 1904 amounts to Rs. 358·24 lakhs. It is to be noted that even this understates the real surplus derived from the railways open to traffic, as the interest charges include the interest on outlay on lines under construction, which, if these lines were being constructed by private enterprise, would be charged to the capital account.

The remainder of the report is mainly technical in its contents, and it well maintains the repute earned by Indian Government statistics for their plentitude of detail and laboured accuracy.

AUSTRALIAN MARKET GARDENING.*

There is an extensive field in the Commonwealth for systematic market gardening, as conducted in Europe and America. In many places the bulk of the vegetable supply is in the hands of Chinese growers, who adopt intense methods of cultivation, too often sacrificing quality to quantity. Although singularly patient and industrious, the Chinese generally adhere to somewhat primititive modes of raising their crops, rarely producing vegetables equal in size or flavour to those exhibited by white settlers at provincial agricultural shows. Many of these exhibits would have a fair chance of securing prizes in the United Kingdom, but the inducements afforded by cereal cultivation prevent settlers from giving much attention to other crops, however promising. With the progress of railway and tramway extension, the opportunities at the command of the market gardener naturally become increased, and by the adoption of improved methods of production, his labours should prove sufficiently remunerative. There are at present few statistical details of the industry, but it has been estimated that in the Commonwealth there are between 34,000 and 35,000 acres under crop, the annual value of the production being about £820,000. Every known kind of European vegetable can be easily raised in some part or other of Australia. Cabbages, cauliflowers, celery, beans, peas, water cress, radishes, &c., are plentiful in metropolitan and suburban markets, but the supply is seldom in excess of the demand. Almost every description of edible root thrives in suitable localities, and amongst other minor crops may be mentioned turnips, mangold wurzel, onions, arrowroot, carrots, parsnips, chicory, and beetroot. Turnips and onions often produce heavy crops, 1,613 tons of turnips having been obtained from 316 acres, and 400 tons of onions from 192 acres. The latter are mostly of the ordinary kinds, the Spanish varieties being somewhat sparingly grown. Leeks and spring onions find a ready market. Mangold wurzel has given 252 tons from 35 acres, while 89 acres under chicory have given 3,578 cwt. Sugar beet, the cultivation of which in Europe has assumed such enormous proportions, thrives remarkably well in many places, but its cultivation for other than agricultural purposes remains limited, although its value for the production of sugar has been fully recognised, the Victorian State Government having expended upwards of £100,000 in an endeavour to develop the beetroot sugar industry. Australian beetroot has furnished, so far as analytic tests are concerned, results superior to those obtained in any other part of the world. Passing to market gardening proper, it may be mentioned that peas and beans are grown for hard fodder for horses, as well as for table use. The peas are gathered when perfectly dry, and are also used for fattening pigs. Those intended for the table include all the best-known varieties. The same may be said of French, broad, and other beans. Cucumbers of superior quality are easily grown, as are pumpkins and melons, which, as a rule, are exceedingly prolific and make excellent jams. In the country districts they are largely utilised as food for cattle and pigs, the spaces between rows of vines or fruit trees in vineyards and orchards being used for their cultivation. Potatoes are grown in all the States. In 1903 there were 116,112 acres under crop, the production being 449,383 tons. In 1904, 88,967 cwt. of Australian-grown potatoes were exported to oversea countries from the Commonwealth, mostly from Victoria and Tasmania. Systematic cultivation on an extensive scale would enable the local markets to become more efficiently supplied, and a valuable export trade in vegetables, both fresh and preserved, to be built up.

* Communicated by Mr. John Plummer, of Sydney, New South Wales.

HOME INDUSTRIES.

Incandescent Gas.—Thirty years ago it was not thought that the London Argand, giving a density of 3·2 candles illuminating power per cubic foot of ordinary 16-candle gas, would be surpassed in its power of developing light from the combustion of coal gas, and as a burner capable of universal adoption, yet a quarter of a century later the Welsbach mantle was giving a light of 80 candles. Of recent years it has been taken for granted that the complete substitution of electricity for gas in the lighting of streets and dwelling-houses was only a question of time, and when the Court of Common Council decided some time ago to substitute gas for electricity for the lighting of certain portions of the City of London the announcement was received with surprise. But the experiment was very successful, and now the Council have returned to gas lighting in Queen Victoria-street, Queen-street, Lower Thames-street, Monument-street, and Fleet-street. In Fleet-street the Gas Light and Coke Company have charge of the new installation, and it is claimed that the street is better lighted at a cost at the rate of £207 per annum than it was by the electric arc lamps which cost £312 a year. And the experience of the other streets named above is said to be similar, a better light being given at something like 22 per cent. less cost. In lighting one of the great objects to be attained is uniformity of illumination, and the avoidance of harsh shadows; and although the gas lamps are not so powerful as the electric arcs, they are more numerous, and, therefore, give a more evenly distributed illumination, with absence of heavy shadows. The light, too, as given from gas burned in incandescent mantles on the high pressure system, has a greater penetrative power in a fog, a very important consideration in cities with the fog capacity of London. The struggle between incandescent gas and electricity for the purposes of lighting involves huge interests. At present it would seem that gas has the advantage, at any rate so far as outdoor lighting is concerned, both in respect to cheapness and penetrative power, but in connection with domestic lighting it has to be remembered that gas lighting injures home decoration, furniture, &c., more than electricity, and matches have to be used.

Dairy Machinery.—A striking point in connection with the Dairy Show just closed was the indication of a growing desire for cleanliness in the transmission of milk from the cow to the consumer. For example, one exhibit was that of an improved can for the carriage of milk from the farm to the shop. It has no seams, is completely smooth on the inside, and has rounded corners, so that there are no crevices, as with the older patterns, for dirt and bacilli to collect in, and it is very easy to clean. In another exhibit by another firm the same principle is applied to the milk and cream cans used by dairymen for the supply of their customers. Here, too, the object is to avoid any receptacles for dirt by putting the milk into a vessel stamped in one piece. For some time past a milk company doing business in the west of London has used glass bottles for this purposes, but the breakage is so great that bottles could never be generally used. And so in other directions, with churns, cream separators, and the like, invention is aiming at what may be called the better avoidance of dirt by means of improved machinery. It is to be noted that Ireland, which not long ago was so much behind the rest of the United Kingdom in the adoption of improved methods of manufacture, is now well to the front. The improvement in Irish methods during the last ten years has been quite exceptional, improvement in manufacture, packing, &c. This is largely, if not entirely, due to the educational efforts of the Irish Agricultural Department, directed by Sir Horace Plunkett, and the growth of co-operation in the form of creameries. English farmers still lag in the rear. They should study Danish and other Continental practice if they would know what co-operation can do.

Cotton Production.—Mr. Egerton, the Governor of Lagos, and Commissioner of Southern Nigeria, speaking in Liverpool last week, told the Chamber of Commerce of that city that in his opinion the British Cotton Growing Association made a mistake at the outset in trying to cultivate cotton themselves on a large scale in West Africa. They could not hope to grow cotton on the sea coast. It is necessary to get to the drier climate of the interior before it can be grown successfully, and there the native should be encouraged to grow cotton, and taught how to grow it successfully. Mr. Egerton's opinion as to cotton prospects on the West Coast of Africa is fully borne out by a report just presented to the Department of Commerce and Labour of the United States. According to this report, in Sierra Leone the Association tried American seeds, but the plantation was not a success. Under favourable conditions Sierra Leone might produce 140,000 bales, but for the next ten years it is not expected that this colony will export more than 6,000 a year. Northern Nigeria, with a population of 20,000,000, and a soil, much of it, admirably suited to the cultivation of cotton, is doing nothing in the way of cotton growing. Lagos, Southern Nigeria, the Gold Coast, Sierra Leone, and Gambia, are capable, says the report, of producing 350,000 bales, but for the next eight years not more than 100,000 can be expected between them. Lack of transportation facilities, and labourers, are the rocks ahead of the cotton cultivation on the West Coast of Africa as in so many other parts of the world. The need for better railway facilities is fully appreciated by both the Imperial and local Governments, which are doing all that it is possible to do, having regard to the limited revenues of the colonies concerned, to supply them. Lagos has already 125 miles of railway, and 70 miles of extension have been sanctioned.

A Hint to Inventors.—The attention of inventors may be usefully directed to the importance of the early patenting of their inventions in Japan, or rather such of them as are concerned with the trade of the Far East. Imitations in Japan of foreign inventions not protected there by patent are not uncommon, Inventions hitherto regarded as having no direct bearing on the trade of the Far East may turn out to have much to do with it, and unless inventors patent their inventions quickly they may find it too late when they become alive to the necessity of patenting. The Japanese Patent Bureau places in its library the official patent gazette of the foreign country containing the description of an original invention, after which such invention is unpatentable, and comes under the clause "publicly known," as covered by article 2 of the Japanese Patent-law.

The Hop Industry.—In a recent reference in the *Journal* to the cultivation of hops, it was said that it is usually in the short cropping years that the losses of other years are made up, and that you cannot lay down any rule that because a crop is a small one therefore it shall be a good or bad one, or because it is a large one, therefore it shall be good or bad. The experience of the present year illustrates this truth. Almost up to the time of gathering the 1905 crop was one of the most promising on record, then came a fortnight of very bad weather, with the result that whilst the total yield of hops is exceptionally large, the quality leaves much to be desired, and it is quality which is the determining factor in relation to profits. "The losses sustained by growers this year" says a report from Canterbury, "are serious, and a large reduction of acreage is certain to take place"; that is to say in a year of the brightest promise almost up to harvest time, the actual result is so disappointing that heavy losses will be incurred. Hop-growing is one of the most speculative of industries, as is shown anew this year.

Wheat Cultivation and Imports.—It is too soon as yet to say whether the remarkable increase in the area under wheat in 1905 will be followed by another increase in the coming cereal year. This increase may be looked for if farmers are persuaded that prices will go higher again, and there would seem to be some ground for the opinion that there will be no sustained fall in prices, notwithstanding present low quotations. The world's wheat crop this year is rather larger than it was last year, but much more than the entire excess is accounted for by the United States and Canada, yet the shipments from those countries, taking the first eleven weeks of the present cereal year, show a decrease of 30·6 per cent. from a year ago, whilst other countries shipped 25 per cent. more. Taking the thirteen weeks of last year ended September 14, the exports from the United States and Canada amounted to 15,396,117 bushels, and from all other countries to 69,078,000 bushels; the figures this year for the same period are respectively 11,783,373 and 87,152,000. We are at the present time drawing our main wheat supplies from four countries, British India, Russia, the Argentine, and the United States. Last year British India sent us nearly six million quarters, and it is hardly likely that quantity will be much exceeded, if it is equalled, this year. The imports from Russia may be expected to be less, and if the imports from the United States continue to shrink, Argentina, and the other wheat exporting centres are not likely to make up the deficiency.

Insurance Business and Inspection.—The insurance scandals disclosed before the Fricke Committee can hardly fail to add materially to British insurance business in the United States, and to diminish proportionately American insurance in the United Kingdom. Four American societies have done an immense insurance business in this country. Not long ago one of them, the least important, but doing a very large business, fell into disfavour for reasons that were shown to be adequate; this was followed by sharp American criticism of a second of the societies, which must have been prejudicial to its English business, and now three of the four are more or less concerned in the discreditable disclosures made to the Committee. And yet official inspection of insurance companies affairs is supposed to be much more complete in the United States then in the United Kingdom. Here under the Life Assurance Act, 1870, and its amendments, each company issuing policies must deposit with the Board of Trade every year its revenue account and balance-sheet of the preceding year, and must at fixed intervals cause an investigation of its financial condition to be made by an actuary, and furnish the public, through the Board of Trade, with the detailed results. In the United States the laws enact still more minute, and much prompter report to the Insurance Departments of the States, and every annual statement is required to show the results of an actuarial investigation, so that the fullest information concerning the business in any year, and the condition of each of the companies is made public early in the following year. Nevertheless misappropriations seem to have been committed upon an immense scale, although the solvency of none of the incriminated companies is questioned.

Insurance in Home Offices.—It is noteworthy that hitherto whilst the life assurance business done by the leading American societies in the United Kingdom has been very large, the amount of life assurance done by British offices in the United States has been insignificant. It is different with fire insurance. The fire insurance business of foreign companies in the United States was comparatively small until 1870, but thirty years later the annual collection of premiums by twenty-four British companies amounted to 35,226,610 dols. Whether, on the whole, the British companies have been considerable

gainers by their American business, is questionable. Be that as it may, the recent disclosures of American methods of management must, for a time at least, check the growth of American insurance business in the United Kingdom. The comparative gain should be great to induce people in the United Kingdom to insure in societies over whose management they can have no control whatever.

OBITUARY.

EARL FORTESCUE. — By the death of Lord Fortescue, which took place on the 10th inst., at his seat, Castle Hill, South Molton, the Society loses one of its oldest members, and one who for many years took a very active part in its work. As Viscount Ebrington he joined the Society in the year 1854, and in the same year he became a member of the Council, and its Chairman, in which capacity he delivered the opening Address of the 101st Session of the Society in November, 1854. He remained a Vice-President of the Society until 1857. He presided at several of the meetings, took part in the discussions, and on several occasions contributed to the *Journal*. The ill health brought on by illness contracted in the Crimea, where he went after the war with a view of improving the conditions of the hospitals, led to his giving up much of his active work in connection with the Society, as well as in other departments of public life; but his interest in, and attachment to, the Society never flagged, and he took occasional part in its proceedings, though he never again served on the Council after his retirement in 1857. As late as 1886 he took part in the discussion on Mr. Willis-Bund's paper on "Fisheries." He was born in 1818, and was educated at Harrow, and Trinity, Cambridge. He was elected a Member of Parliament in 1841, and represented Plymouth, Barnstaple, and Marylebone, until his retirement in 1859, in which year he was called to the Upper House in his father's barony of Fortescue. Two years later, in 1861, he succeeded to the earldom. He held several minor political offices, but the condition of his health prevented his taking a more active share in the work of the Government. He was always known as a staunch advocate of education and of sanitary improvement. Commencing life as a Whig, he always remained a persistent advocate of Liberal principles, though he separated himself from his party on the Eastern question of 1878-79. Until the end of his life he remained a Liberal Unionist.

GENERAL NOTES.

ESPARTO GRASS.—In his report on the trade of the Regency of Tunis (No. 3492, Annual Series) Mr. Consul-General Berkeley says that a new company, called La Société Franco-Africaine des Pâtes d'Alfa, has been found to undertake the local manufacture of paper from esparto grass by means of a new process discovered by a French chemist, M. de Montessus. At present, Algeria and Tunisia export annually about 200,000 tons of this grass, which is almost exclusively shipped to the United Kingdom. The new process consists in rendering soluble the gum and resin contained in the grass by means of fermentation produced by bacteria. The grass is then washed in a carbonate solution, so as to separate, intact and free from foreign bodies, the cellular fibres which constitute a paste similar to that used in the United Kingdom for the manufacture of paper. This fermentation process is said to give exactly the same results as the British process, and it is alleged that it will reduce the present manufacturing price by 175 francs per ton. It is not improbable that the company will seek to obtain special advantages for the collection of the esparto grass which they will need.

ARTIFICIAL SILK. — There seems to be a considerable demand for artificial silk for embroidery and trimmings, and several manufactories have been started in Lyons with a view to producing it on a large scale—a factory at Izeiux (Loire) employing the Givet system, which treats cotton cellulose with salts of copper; factories at Feyzin (Rhone) which follow the system of Chardonnet; a factory employing the Valette system; and a factory in the Department of Ardèche for the manufacture of "Viscose," product obtained from the cellulose of wood pulp without nitration. Referring to the progress of the industry, Mr. Consul Liddell (No. 638, Miscellaneous Series) says that time only can show which of these different systems is most successful, but in the meantime it is not unlikely that over-production will take place.

GLEBE LANDS ACT, 1888.—For some years after the passing of this Act the transactions under it were small. The number of cases in which the assistance of the Board of Agriculture was resorted to in connection with the sale of glebe lands in the first ten years after the commencement of the Act averaged 52 per annum only. In the three years 1899-1901 the average number of completed transactions rose to 77 per annum, while in the three years 1902-4 the average was 125, the figures of the past year amounting to no less than 162, covering 2,835 acres, the aggregate purchase-money being £135,658. In 1903, 102 sales, comprising 2,179 acres, were carried out, and the purchase-money paid was £69,905. The amount of the official fees received in respect of the Glebe Lands Act during the financial year 1903-4 was £419 15s. These facts and figures are taken from Major P. G. Craigie's report to the Board of Agriculture and Fisheries (Cd. 2453).

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PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

RESERVOIR, FOUNTAIN, AND STYLOGRAPHIC PENS.

By James P. Maginnis,
A.M.Inst.C.E., M.Inst.Mech.E.

Lecture I.—Delivered January 23, 1905.

Ancient Writing Implements.

There does not appear to exist, except on the shelves of the Patent Office, any systematic record of what has been done to produce the elegant and perfect writing instrument of to-day, known as the "Fountain Pen."

It is probably to many unknown history, but on the other hand, a large number of persons must be well acquainted with what has been done in the past to perfect the writing implements which have become so familiar to all; for in these days of advancement it would be difficult to find anyone incapable of using a pen.

Many inventors, and some of these of the first rank, have devoted much time and ingenuity to the subject, with the object of producing a reliable instrument.

It will perhaps astonish some of my audience when I refer to early inventions, as there is a general belief that fountain pens are of quite modern date.

The time at my disposal will not permit of a complete reference, but I shall endeavour, by short description, drawings and photographs, to present most of the leading types, more or less in detail, and I have been enabled, to a great extent, to do this by the generous assistance of leading manufacturers in England, the United States, and elsewhere, who have readily placed valuable information at my disposal for the purposes of these lectures.

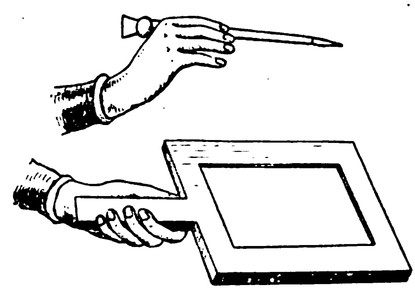
It is necessary to emphasise the fact, that I merely speak as an outsider, a man in the street, from the unbiassed standpoint of one who finds recreation and instruction in endeavouring to ascertain the why and the wherefore of articles of utility. I have, therefore, no axe to grind, unless it be to call the attention of the younger members of my audience to the pleasure to be derived from the occupation of tracing the history of inventions.

To trace the history of fountain pens, is the primary objective I have in view, but I think that a hasty *résumé* describing the growth of writing implements generally from early days, would perhaps make the subject a little less prosaic, and to some extent reduce the result of my research to something more interesting than a mere catalogue of inventions, however instructive such a catalogue might be.

In D'Israeli's "Curiosities of Literature" we read: "When men had not yet discovered the art of recording events by writing, they planted trees, or they erected rude altars, or heaps of stones as remembrances of past events." And again: "Hercules probably could not write when he fixed his famous pillars."

Stylus and Tabula.—As long as people wrote upon tablets covered with wax, they were obliged to use a style or bodkin, made of bone, metal, or some other hard substance. A curious

Fig. 1.



drawing in a fine manuscript, once the property of Charlemagne, and now preserved in the public library of the ancient city of Treves, on the Moselle, furnishes the illustration (Fig. 1) here

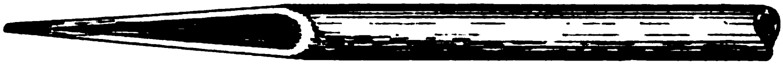
shown of a tabula held by a handle in the left hand of the scribe, exactly resembling the old horn book of our village schools. The surface is covered with wax, to be inscribed by the metal style held in the right hand. These styli were sometimes surmounted by a knob, but frequently were beaten out into a broad flat eraser used to press down and prepare the waxen surface for a new inscription. The stylus here shown illustrates both knob and eraser, or burnisher. (Fig. 2.)

Fig. 2.

Ancient Roman Stylus.

When it became usual to write with coloured liquids, scribes employed a reed, and later, quills or feathers. It is rather astonishing that there is no authentic record as to the precise kind of reeds the ancients used for writing, though writers mention the places where they grew wild, and where it is highly probable they grow still. It is, however, reasonable to suppose that the same reeds are used even at the present time by all the Oriental nations, for it is well known that among the people of the East, old manners and instruments are not easily banished by new modes and new inventions.

Fig. 3.



Reed Pen—as still used in the East.

Reed Pen.—Most authors who have treated on the history of writing have contented themselves with informing us that "a reed was employed," but the genus of grasses called by the ancients "Calamus" and "Arundo" is more numerous in species than the genus of grasses to which their corn belonged. A writer—Chardin—speaks of the reeds which grow in the marshes of Persia, and which are sold and much sought after in the Levant, particularly for writing. Chardin says, "Their writing pens are made of reeds, or small hard canes of the size of the largest swan quills, which they cut and slice in the same manner as we do quills, but they give a much longer nib." These canes or reeds are collected along the Persian Gulf, in a large fen. They are cut in the month of March, and when gathered are tied up in bundles and buried for six months, when they harden and assume a beautiful polish and colour—a mixture of black and yellow. None of these reeds—Chardin says—are collected in any other place. As, he says, they make the best writing pens, they are transported throughout the whole East.

Although the reeds were split and formed to a point like our quills (Fig. 3), it certainly was not possible to make such clean and fine strokes, nor to write so long and so conveniently with them, as one can with quills. The use of them, however, was not entirely abandoned when people began to write with quills, which in every country can be procured from a bird extremely useful in many other respects. Had the ancients been acquainted with the art of employing goose-quills for this purpose, they would undoubtedly have dedicated to Minerva, not the owl, but the goose.

A writer in the fifth century states that Theodoric, King of the Ostrogoths, was so illiterate and stupid that during the ten years of his reign he was not able to learn to write four letters at the bottom of his edicts. For this reason the four necessary letters were cut for him in a plate of gold, and the plate being laid upon paper formed a stencil from which he is said to have traced the characters with a quill.

This account is not improbable, for history tells us that almost about the time of Theodoric the Western Empire was governed by the Emperor Justin, who also could not write, and who used, in a like manner, a piece of wood having letters cut in it, but in tracing them out he caused his hand to be guided by one of his secretaries.

The English word "pen," the French "plume," and the German "feder" all signify the same thing, a "wing feather." There are many traces that quills were used as writing instruments by the ancient Romans. Perhaps the earliest specific allusion to the quill occurs in the writings of St. Isidore, of Seville, early in the seventh century.

For a long time goose quills were solely used, but afterwards the wing feathers of swans, turkeys, peacocks, and crows were requisitioned. The goose quill, described by Byron as—

> Nature's noblest gift,—my greygoose quill!
> Slave of my thoughts, obedient to my will,
> Torn from thy parent bird to form a pen,
> That mighty instrument of little men!

was until 1830 almost the only kind of pen in general use, but it must not be supposed that pens made of various metals did not exist many years previous to 1830.

It is recorded that the Patriarchs of Constantinople, under the Greek Empire, were accustomed to sign their allocutions with tubular pens of silver, similar in shape to the reed pens, which are still used by the Oriental nations. The Chinese and Japanese, however, write with a brush or hair pencil dipped in Indian ink.

Other writers of the seventh century refer to quills in a vague manner, and it is not quite clear whether feathers or reeds are meant. Men of letters, well versed in such matters, assure us, from comparison of manuscripts, that writing reeds were used along with quills in the eighth century, at least in France, and that quills first began to be common in the ninth century.

In convents, it is said, reeds were retained for the writing of texts and initials of manuscripts, whilst for small writing, quills were everywhere employed. This statement must be taken with reserve, as it is probable that scribes and copyists would at first endeavour to write with quills in the same style as had been the custom when using reed pens, in order that the results might not seem very very different from the then usual style. And with quills one can produce writing both coarse and fine. About the year 1433 writing quills were so scarce in Venice, that it was with great difficulty men of letters could procure them.

Inkhorn and Penner.—The scribes of the Middle Ages frequently carried their writing implements appended to their girdles, consisting of an inkpot and a case for pens. The latter was usually formed of leather softened by hot water, and then impressed with ornament, and hardened by baking. This was as strong as horn, of which substance the inkpot, or inkhorn, was generally made.

The drawing shown on the screen is reproduced from an engraved brass to the memory of a notary of the time of Edward VI., placed in a church at Ipswich, representing a penner and ink-horn slung across the man's girdle. It will be seen that they are held together by cords which slip freely through loops at the side of each implement, the knob and tassel at each end preventing them from falling.

Writing Table of a Scribe. — With the invention of the printing press the very laborious process of producing books by handwriting vanished for ever. Imagine the working table of a scribe, contemporary with the invention of the printing press, as depicted in a picture in the gallery of a museum in Naples. The pages upon which he is at work lie upon the sloping desk. In the table beyond he has stuck his penknife. The pens lie on the standish in front of him. Bottles of ink of both red and black colours are also there, and an hour glass is at hand to give him due note of time, not necessarily because he was in any particular hurry, for they seemed to have plenty of time in those days. A pair of scissors and a case for a magnifying glass to assist his sight, are also within easy reach.

Eastern Writing Implements. — Another such picture shows the writing materials and implements as used even to-day in Palestine. The scribes do not carry the genuine inkhorn nowadays, as did the prophets of old, but instead they have an apparatus consisting of a metal or ebony tube for reed pens, with a cup or bulb of the same material attached to the upper end to contain the ink. This tube they thrust through the girdle and carry with them at all times as we carry our pencil or fountain pen, always ready for use.

Brass Reed Tube and Ink Bulb.—I am indebted to my friend Mr. A. Hervé Browning for kindly affording me the opportunity to show you this illustration. Mr. Browning lent me the original from which Fig. 4 has been photographed. It is an actual example of one

of these tubes and inkpots, which was shown on the last slide. It is made of brass, and is richly carved all over its surface. The ink

FIG. 4.

used in it was of a semi-fluid consistency, and in order to prevent its flowing from the ink bulb a piece of sponge was inserted.

Portable Ink Bottle.—Many will remember the general use, not a great many years ago, of a glass bottle so formed as to be safely carried with its neck inserted in the button-hole of a coat, and it will be evident to most that it forms a survival of the inkhorn.

Japanese Writing Box.—Here, in Fig. 5, is an interesting photograph of the writing box as used to-day by the Japanese, at home and in business. In the centre of

FIG. 5.

the box is a slab or palette of stone, formed with a sloping surface, becoming gradually deeper, till a well is formed at the further end. A supply of water is kept in the little bronze vessel seen beyond. When ink is required, a little water is poured on the slab, and Chinese or Indian ink is rubbed upon it till of the right consistency, just as we engineers and architects rub up Indian ink for the preparation of drawings. The writer then fills one of the pens which you see in the box, and which are really brushes, and proceeds to make the wonderful marks which in his language represent words and sentences. The pens are made from the hair of deer, sable or rabbit, fixed in reeds.

I may here say that I am indebted to Captain Sparks, of Duke-street, Manchester-square, for the specimens of Japanese pens, and also to Messrs. Yamanaka, of New Bond-street. who very generously lent me this writing box as well as the following objects.

FIG. 6.

Japanese Pen Tube and Ink Box (Bronze).—Of course the Japanese have their portable writing implements. Fig. 6 shows the kind of thing the milkman, the baker, or the tax collector carries in his sash when he goes on his rounds. It is made of bronze. The tube contains his pen, whilst the beehive-shaped box at the other end of the silken cord contains

ink. It will be seen that the box consists of two compartments, the lower one contains the Indian ink in a sponge, and the upper compartment holds some red endorsing ink with which he charges his business seal with ink, and endorses his little bill or receipt.

Japanese Pen Tube and Ink Box (Ivory).—In Fig. 7 we see a more elaborate form of the same kind of implement, made of ivory. The stem is hollow, and holds the pen. The whole

FIG. 7.

is richly carved, as is also the bowl containing the sponge saturated with ink. It will be noticed that the general outline of this is very similar to that of the reed tube and ink bulb already referred to.

From the stylus of the ancients to the goose quills of our fathers was a great step in advance, but the requirements of advanced civilisation demanded still further strides. The softness of quill pens and the constant trouble required to mend them and keep them in working order naturally led to the search for some more enduring substitute.

Quill Nibs.—In September, 1809, appeared an application from Joseph Bramah (3260) for "a new method of making pens, penmaking machines, &c." This is interesting, as it marks the date when quills were first cut up into several pieces, and as many nibs were formed therefrom. He describes how the quill may be cut longitudinally into three or even four parts, and each of these cut transversely into two, three, four, or even five parts, and a writing point formed at each extremity of these subdivided lengths. He then goes on to describe a machine whereby the quills may thus be treated. I shall have occasion to refer to this specification later.

In October, 1818, Charles Watt (4299) describes a process for gilding and preparing quills and pens by manual labour and chemical operations, so as to render them more durable and useful. He describes the process of cleaning and dipping in a dilute aqueous solution of the nitro-muriate of gold, treated with phosphuretted hydrogen gas; then sulphurous acid gas, until finally, after repeated treatment, a thick coating of gold is deposited.

Quills with Steel Nibs.—In 1852, Myers and others obtained a patent (525) for the making of pens or nibs to be applied to quill holders. The specification also describes the shaping of quills at the end, so that they might be used as ordinary penholders to hold the nibs in general use.

Three years later a somewhat similar arrangement was patented (591) by William Hill.

The specification (7333) of Henry Stephens, of March 1837, refers to certain improvements in pens for writing. He employs quill, horn, or other animal substance of the requisite thickness, which he cuts into proper forms by means of a cutting punch or other instrument. A pair of dies shaped according to the model or required curved or bent form of the pens intended to be made, are heated to a degree sufficient to harden the materials without destroying their texture; the cut pieces or blanks are placed between them, subjected to pressure, and not removed till the dies are quite cold, when the nibs will have become set or fixed in the required form. In order that the slit may not be allowed to pass too high up, the pen is placed under a cutting punch and die, and a small hole is perforated at the place to which the slit is to extend. It is also stated that the curving process may be performed first, and the cutting and shaping afterwards. A penknife may be used to remove any roughness, and also to adjust the points.

Charles Goodyear in 1853 describes a process (1693) for making pens of vulcanised india-rubber, composed of two parts by weight of india-rubber and one part by weight of sulphur. This is rolled out into a thin sheet of the thickness of a strong quill, and then cut up into suitably narrow strips, which are placed between moulds made of glass, one being concave and the other convex, and subjected to heat gradually increased to about 295° to 350° Fahr., and afterwards allowed to cool gradually, when the curved strips are taken from the moulds, cut into lengths, and made into pens.

In the specification (1856) of Henry Peters

in 1853 the inventor states :—"My improvement in pens consists in making them of tortoiseshell, and the other shells called tortoiseshell in commerce."

He presses thin sheets of such shell into a semi-cylindrical form, and from these he cuts the pens and fashions them by any suitable means. He states that pens made of tortoiseshell have all the desirable properties of quill pens and last much longer, and, like the quill, when worn can be mended in the same manner.

In 1859 (68) Edward Cobbold proposed making his pens principally from strips of reed or cane. These he divests, at intervals, of the soft spongy material which lines the interior. The pens are made from the hard outer shell, while the soft part forms a stop to the slit. This would appear to be a retrograde suggestion rather than an improvement.

In 1861 (2112) Evans and Concanen describe how pens may be made from horn in its natural structure, or dissolved and formed into horn sheet by ordinary process. Blanks are stamped or cut out from the sheets, softened by the heat of steam or other means, moulded into pen form, provided with slits, and allowed to resume the natural state of the horn from which they were manufactured.

In the invention of George Leslie in 1861 (2828), the pens are made of hardened caoutchouc, gutta percha, or gum, known as vulcanite or ebonite. The inventor moulds them into the proper shape while the gum is in a plastic state, and hardens them by the ordinary process, or shapes them with files or other tools, after the material has been hardened and become vulcanite or ebonite.

These examples will tend to show that quill pens were not considered perfect as writing implements. They were too troublesome to keep in order, and there was an evident desire to produce something more enduring.

It must not be supposed that I have cited anything like all the attempts that have been made to improve the quill, but I have selected these typical examples as illustrative of my suggestion that something better was required.

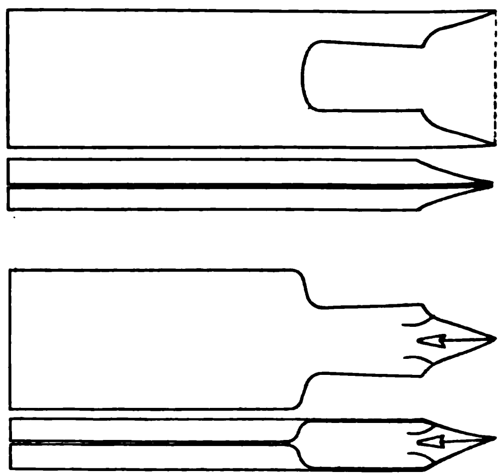
It is recorded that metal pens were used in the fifteenth and sixteenth centuries, and a writer (in 1733) refers to steel pens. The following interesting note appears in a manuscript document in the library of Aix-la-Chapelle, entitled, "Historical Chronicle of Aix-la-Chapelle," second book, year 1748, edited by the writer to the mayoralty, Johann Janssen. He says :—

"Just at the meeting of the Congress I may, without boasting, claim the honour of having invented new pens. It is, perhaps, not an accident that God should have inspired me at the present time with the idea of making steel pens, for all the Envoys here assembled have bought the first that have been made, therewith, as may be hoped, to sign a treaty of peace which, with God's blessing, shall be as permanent as the hard steel with which it is written. Of these pens, as I have invented them, no man hath before seen or heard. If kept clean, and free from rust and ink, they will continue fit for use for many years. Indeed a man may write twenty sheets of paper with one, and the last line would be written as well as the first.

"They are now sent into every country of the world as a rare thing, to Spain, France, and England. Others will no doubt make imitations of my pens, but I am the man who first invented and made them. I have sold a great number of them at home and abroad at 1s. each, and I dispose of them as quickly as I can make them."

Barrel Pens as First Made.—There are many others who lay claim to having made the first steel pens, but the late Sir Josiah Mason has stated that his friend and patron, Mr. Samuel Harrison, a maker of split-rings,

FIG. 8.



such as are used for keys, made a steel pen for Dr. Priestley about the year 1780. He, Harrison, took a sheet of steel, made a tube or barrel of it, the edges meeting to form a slit. He then filed away the edges of the tube in such a manner as to form a rough barrel pen. The illustration (Fig. 8) shows how the pen was fashioned, the slit extending right along the back of the barrel, not merely at the point as in the modern method shown below. The upper drawing in each instance illustrates

the form each pen would assume if flattened out.

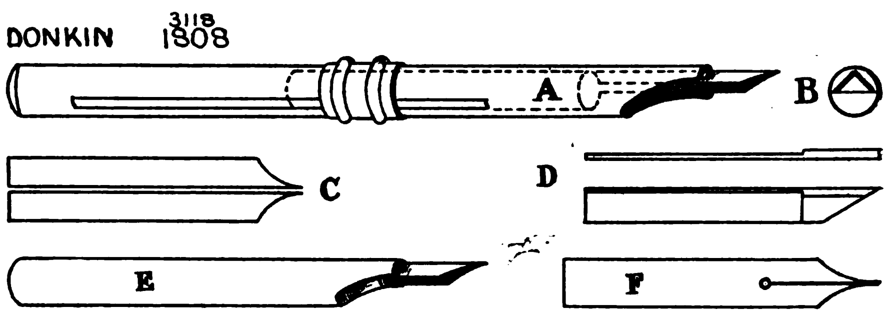
Harrison's method was improved upon by a blacksmith named Fellows, of Sedgeley, Worcestershire, who punched a rough "blank" out of thin sheet steel. He then formed this blank into the barrel shape, and while the metal was soft marked the place where the slit was to be with a sharp chisel. Before tempering, this mark was "tabbered" or gently beaten with a small hammer until it cracked right through, thus forming the slit. Fellows began making pens in 1795, and was able to produce them at from 18s. to 30s. a dozen, whereas Harrison's were 5s. each.

Donkin's Pens.—In 1808 Bryan Donkin applied for and obtained the first patent (3118) for metal pens. He claims a pen upon a new construction, and states that the pen may be duced in Fig. 9, redrawn from his specification.

Specimens of these pens are to be seen in the Educational Department of the South Kensington Museum.

Perry's Pens.—In the patent (5933) of James Perry, of April, 1830, we have an improvement in pens, consisting in producing them from hard, thin, and elastic metal, with the necessary flexibility, and a length of slitted or cleft space scarcely exceeding that of quill pens. The result is effected, first, by a central aperture space or hole of circular, oval, square, or other shape, formed in the pen between the nib and the shoulders, or, secondly, by making between the nib and the shoulders one or more lateral slits on each side of the central slit, and rising out of or branching from it. The pens, the patentee states, should be made of the very best spring steel, and they

FIG. 9.



of any "metal or material fit and proper" for the purpose. It is made of two parts as shown at C "flat or nearly so," having those parts of the flat sides opposed to each other, and forming the slit of the pen, rather thicker towards the points as shown at D, in order, as he says, to prevent the pen from spluttering. They are then put into "a tube or other fit receptacle," "applied to each other in an angular position," as shown at B, and thus constitute a pen.

Another method is to form the pen of one single flat piece, as shown at F, afterwards bent to the proper angle, before inserting it into the tube E. To increase or diminish the elasticity of the pen, the inventor suggests its being placed further out, or within the tube holder A, a slide being provided for this purpose. The patentee states that these nibs may be made of steel, brass, silver, gold, platinum, or any other suitable metal or material. Mr. Donkin's illustrations are repro-

should be of about the same diameter as those made from quills. It has been suggested that Perry got his idea of making steel nibs from having seen the quill nibs of Bramah, and there is probably some foundation for the suggestion. Hitherto, pens had only been made in barrel form in imitation of the reed and the quill, except in the case of Donkin's invention, which does not appear to have found much favour.

With such a variety of nibs as are to-day everywhere obtainable there ought to be no difficulty in finding one to suit every style of writing, from the hair lines of the lithographer, to the broad, bold lines of the German text employed in engrossing legal and other documents. There certainly is no valid excuse for him who can never find a decent pen. And considering the many processes through which the pen of to-day passes before it is considered fit to place before a critical public, it is marvellous that pens can

be bought at prices so low as fourpence a gross, which formerly cost as much as eight shillings a gross.

Perhaps I may now be permitted to give some general idea of the interesting growth of the steel pen of to-day, from the time of the punching out of the "blank" from the strip of very high quality steel from which it is taken.

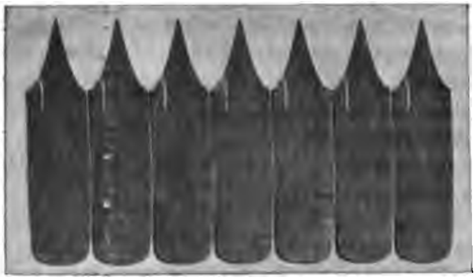
Cutting Out.—The steel of course is in an annealed state, easily manipulated without fracture, and here is a photograph of a group of "blanks" (Fig. 10) as they fall from the die

FIG. 10.

of the fly press, operated by girls, who become very deft and skilful at their work. The punching of the steel is so rapidly and neatly executed as to be done with mathematical precision. It will be found on examination that the intervals between the perforations are perfectly uniform. Having perforated the entire length of the ribbon of steel along one edge, it is quickly reversed, and the other edge is treated in a similar manner.

Side Slitting.—The next operation is that of forming the two side slits (Fig. 10A) which give

FIG. 10A.



elasticity to the nib. I need not now go into details as to how the various processes and operations are carried out, but will pass along from one to the other.

Piercing.—This operation has already been referred to, and the object of the existence of the "pierce" explained. Of course there are many nibs made without a pierce, notably gold ones, but most steel nibs are pierced to give them elasticity, and to increase their ink-holding capacity.

Marking.—Manufacturers who are proud of their productions take a pleasure in stamping their name on the nibs they make, and in order to identify one kind of nib from another, a mark, or a letter, or a name is stamped on the nib to be seen of all men. On the other hand, there are manufacturers so modest, that for a mere consideration, they will stamp some one else's name on the nibs they make. In the illustration, we have the name of Joseph Gillott, whose name is known throughout the civilised world.

Annealing.—The various manipulations having somewhat hardened the steel, it becomes necessary to soften or anneal the blanks previous to further development of the nibs. They are moderately hard, but before they can be made to assume the familiar curved form, it is necessary that they should be considerably softened, so as to be of a more yielding disposition, and to effect this quantities of the immature nibs are placed in iron pots, afterwards carefully covered with charcoal dust, and sealed to prevent the entrance of furnace gases. Thus prepared, the pots are placed in larger pots of the same kind and again covered and sealed, and then placed in a muffle furnace till they become of a dull red heat, when they are taken out and allowed to cool. The blanks have now become soft and pliable, readily taking the various shapes into which pens are formed by stamping and embossing presses.

FIG. 11.

Raising.—There is now no difficulty in making the blanks assume the appearance here shown in Fig. 11 by a process technically known as "raising," but, as the nibs are soft, their constitution having become limp and

enfeebled from the recent annealing process, they must be braced up anew in the hardening tub, for now they have no more elasticity than so many pieces of lead. They look like nibs, and that is all.

Hardening.—Hardening is accomplished by heating the nibs to a dull red, having placed them first in shallow pans, and then, when at the right heat, which is estimated by their colour, they are overturned into a bath of oil, from which they are afterwards removed, having a greasy, black, disreputable appearance, and a temper as brittle as glass. Boiling in a strong solution of soda and water removes the grease and impurities, and the nibs emerge with a white and clear complexion, but they are much too brittle.

Tempering.—They have next to submit to the process of tempering, which is effected by placing a quantity of them in an iron cylinder, capable of being slowly revolved over a fire, or gas jet. Under this treatment, as everyone knows, they change colour with perfect regularity, and as soon as they are seen to assume a dark blue colour they are taken from the fire and allowed to cool.

Cleaning.—The nibs, however, again require to be cleaned to remove the impurities caused by heating and handling. They are therefore put into tumbling barrels, containing water and powdered fireclay, the fragments of crucibles and foundry melting pots, mixed with emery. These barrels are kept revolving for some time, till by abrasion the nibs are at length polished with a surface like silver.

Straight Grinding.—To improve the flexibility of the nibs, they are now ground near the points in a longitudinal direction, equivalent to the scraping of a quill pen with a penknife.

Cross Grinding.—And then they are ground in a transverse direction, a process which gives them a smart appearance.

Messrs. Gillott had an ingenious little machine in their works in Birmingham, which automatically gronnd the nibs, first in one direction and afterwards in the other direction as described, at the rate of about twenty-four in a minute, the pens being fed into the machine at this rate by hand. After grinding, the nib was released and projected with considerable force along a tube, and into a basket placed below. On the occasion of a Royal visit to Messrs. Gillott's works, His Majesty King Edward the Seventh, then Prince of Wales, was much interested in the little machine, and having watched its lifelike movements for some time, caught one of the flying nibs as it emerged from the tube, the result of which was a small puncture of the palm of the Royal hand. This incident gave rise to the naming of the machine, which my guide (who narrated the incident to me when I visited the works) introduced to me as the "Royal Blood Machine."

Slitting.—Perhaps the most important process in the making of a nib, remains to be carried out. It is that of slitting, but time will not permit me to go into the method in detail. Suffice it to say that the slitting is now accomplished, and if properly done, a perfect nib is the result.

Colouring.—In order to improve the appearance of the nib, or as a distinguishing feature, it is now coloured by a gentle heating, which gives it the familiar bronze colour. Or, sometimes the nibs are plated with copper, or gilt, or nickel-plated.

Varnishing.—Finally they are varnished by immersion in a solution of shellac dissolved in spirit, made to adhere to the nibs by gentle warmth. When dry, they are examined carefully, all defective nibs being rejected, weighed into grosses, and carefully packed in neat cardboard boxes, ready to be introduced to the world as an instrument "mightier than the sword." At the present time, there are about thirteen, or more firms engaged in the penmaking trade in Birmingham alone, consuming about 28 tons of steel per week in the production of pens and penholder tips. Besides the British factories, there are some four or five on the Continent, and perhaps only two or three in the United States. In Birmingham alone, the average weekly production equals about 250,000 gross, or 36,000,000 pens, finding employment for some 4,000 women and girls, and about 650 men and boys. In addition to these, about 300 more women and girls are employed in making the neat paper boxes in which the pens are packed. That the industry is an important one there can be no doubt. Messrs. Gillott's works in Birmingham are very extensive, and those of Messrs. Perry and Co. are no less important. Messrs. Brandauer also have a huge factory. Besides these there are other works in Birmingham of equal importance, such as John Mitchell's, Myers and Sons, William Mitchell's, and others whose names are familiar to all.

Many attempts have been made to find a substitute for steel in the manufacture of pens. It is not a great many years since it was almost an impossibility to find an ink that did not rapidly corrode metallic pens, by reason

of the ingredients used in its manufacture. Even to-day we are warned that certain inks are highly corrosive. Several patents were granted to inventors for the application of certain metals, other than steel, to the making of pens, and the following are a few of them, by way of example.

In 1822, Hawkins and Mordan describe certain improvements in pens (4742), consisting in making them of tortoiseshell or horn, and impressing into the wearing parts, when they are softened with hot water, small particles of diamond, ruby, or other very hard substance. And again :—In lapping a small piece of thin sheet gold over the end of a piece of tortoiseshell, and pressing the gold into it whilst in a soft condition. The pen is afterwards formed by cutting away the superfluous gold and tortoiseshell together. And again :—By applying to the nibs of pens of tortoiseshell, horn or quill, small particles of diamond, ruby, or other gem, causing them to adhere by a suitable varnish or cement unaffected by ink.

Scully and Heywood, in 1855 (2084), suggest that, by reason of its non-oxidisable qualities, aluminium may be used in place of brass, copper, and silver, for wind and stringed instruments, and also as a material for pens, penholders, and inkstands. The metal for pens they propose to roll or beat into thin sheets, in order to give rigidity and toughness to it, and then, by ordinary means, the pens may be made from these sheets.

In the invention of Bewicke Blackburn (804) in 1857, each pen is formed of two pieces of glass or porcelain (set in a frame of metal or some other flexible material) composed of two parts, separated from each other in such a manner that the flexibility of the frame will admit of the points of the pen separating or expanding, and contracting when writing.

In the months of February, March, and May, 1863, three distinct groups of inventors (Robert Pinkney 455, Lutwyche and Lutwyche 682, and Page and Wayne 1165) applied for patents for making pens of aluminium bronze, composed of aluminium and copper in varied proportions. This appears to be a peculiar coincidence.

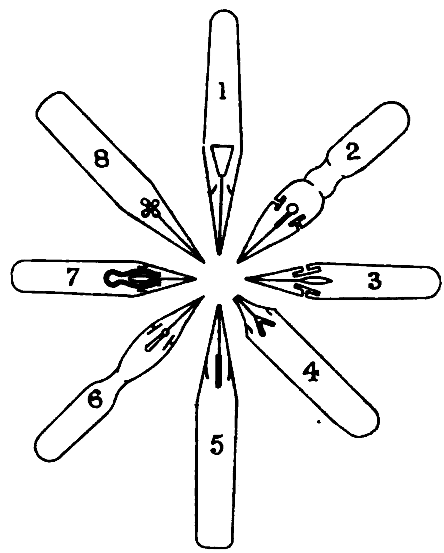
In the invention of Louis (1711), in 1876, the pen is to be of gold, of not less fineness than 16 carats, covered with vulcanised indiarubber, and provided with an iridium tip or point.

These are specimens of the many efforts on record of inventors striving to improve the pen, and one cannot help but admire the ingenuity and skill, as well as the perseverance which such records represent. On the other hand, it was no doubt assumed, that considerable fortunes were to be realised in case of success. Experience has shown that a greater harvest of wealth has over and over again been reaped by the inventors of small articles of general utility, than has fallen to the lot of originators of more pretentious inventions.

Reservoir Pens.

Many attempts have been made to increase the ink-holding capacity of the ordinary writing pen, or nib. As already mentioned,

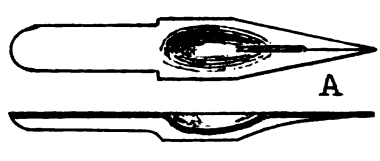
Fig. 12.



one method of attaining this end, was the provision of an orifice or "pierce" as it is technically called, some examples of which are shown in Fig. 12.

Some nibs were provided with deep recesses or pockets as shown in Fig. 13 (A), Fig. 14 (B), Fig. 15 (429, 1883). Another favourite method

Fig. 13.



was that of folding over the sides of the nibs. The nib was stamped out provided with wings, which could be folded, so as to form an ink reservoir under the nib, as in Fig. 16 (C), Fig. 17 (1616, 1890), and Fig. 18 (10984, 1884).

FIG. 14.

FIG. 15.

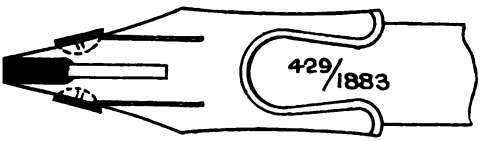


FIG. 16.

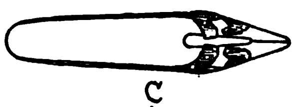


FIG. 17.

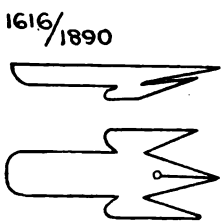
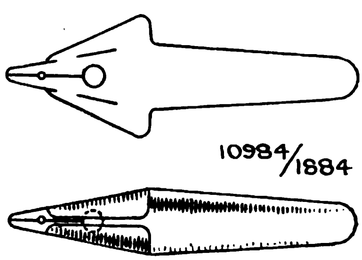


FIG. 18.



Sometimes a portion of the nib was so punched out that it could be folded over on the back of the nib, as in Fig. 19 (6824, 1894), and Fig. 20 (7,484, 1897). Or underneath the nib, as in illustrations Fig. 21 (A), and Fig. 22 (B),

FIG. 19.

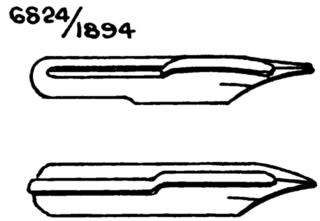


FIG. 20.

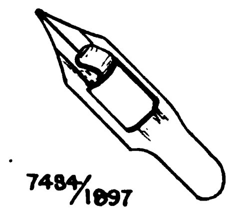


FIG. 21.

FIG. 22.

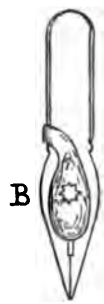
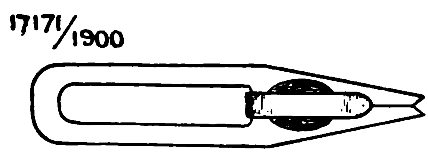


FIG. 23.



the space thus formed providing accommodation for a considerable quantity of ink. In some instances the folded part was used as a clip as in Fig. 23, to hold a pellet of aniline matter, so that on dipping the nib in water, a writing fluid resulted. Messrs. Perry and Co., some fifty years ago, introduced a similar

nib, having an aniline pellet cemented underneath, and these nibs were sold at what now appear to be very extravagant prices.

Not uncommonly nibs were provided with additional parts, which were either fixed by clips or other means, as shown by Fig. 24 (A), Fig. 25 (3818, 1883), Fig. 26 (12760, 1896), and Fig. 27 (13533, 1891), and also in Fig. 28 (503, 1891), Fig. 29 (17151, 1888), Fig. 30 (3204, 1900), Fig. 31 (10606, 1897), and Fig. 32 (3823, 1887, or were slipped into the penholder together with the nib, as shown in Fig. 33 (16516, 1888), Fig. 34 (12999, 1896), Fig. 35 (20862, 1895), Fig. 36 (21138, 1891), Fig.

FIG. 24.

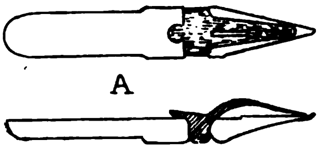


FIG. 25.

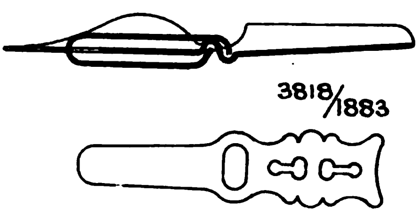


FIG. 26.

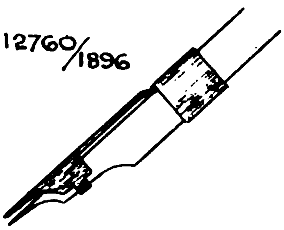


FIG. 27.

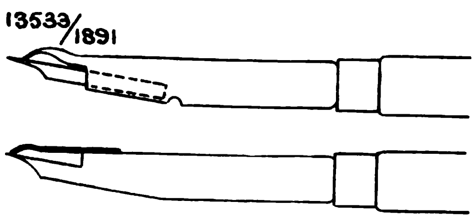


FIG. 28.

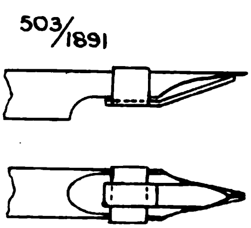


FIG. 29.

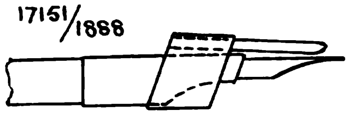


FIG. 30.

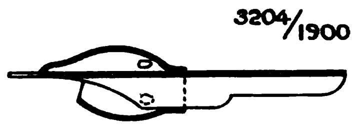


FIG. 31.

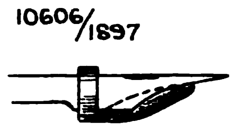


FIG. 32.

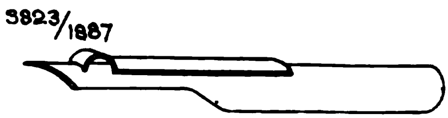


FIG. 33.

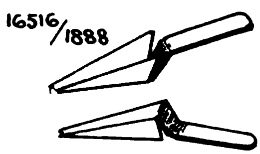


FIG. 34.

37 (A), and Fig. 38 (15309, 1886), or were part of the penholder, as in Fig. 39 (B). Another form was that in which the sides of the nib were bent into trough form, and a wire

FIG. 35.

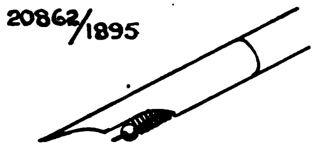


FIG. 36.

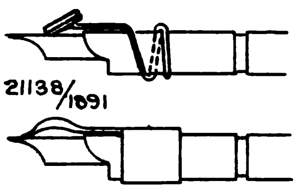


FIG. 37.

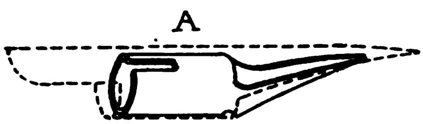


FIG. 38.

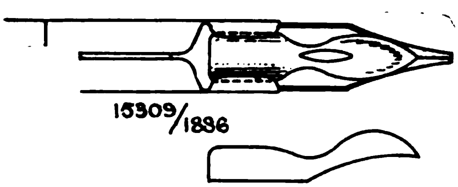
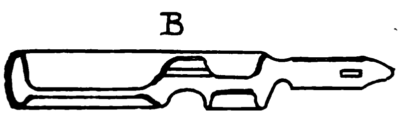


FIG. 39.



having a coiled loop was attached to the nib, lying along the bottom of the trough as in Fig. 40 (16235, 1891), or a fine wire was wound around the point of the nib, as shown in Fig. 41 (2328, 1889).

In the illustration Fig. 42 (155, 1883) we have a kind of barrel pen having a reservoir formed underneath the writing point, whilst the "barrel" may be inserted in a tubular holder containing a supply of ink which would gravitate to the point.

FIG. 40.

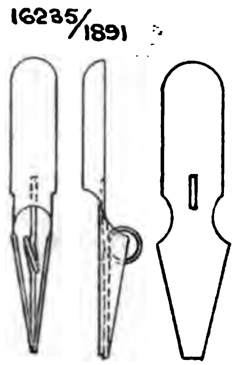


FIG. 41.

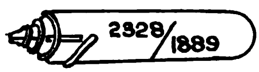


FIG. 42.

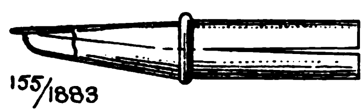


FIG. 43.

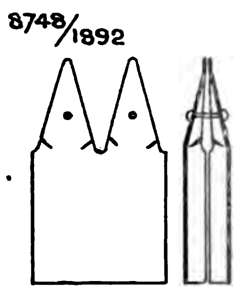


Illustration Fig. 43 (8748, 1892) shows a barrel pen formed from a flat piece of steel, bent into a tube, tapering towards the point. And the adjoining illustrations Fig. 44, (13665, 1888), show a somewhat similar pen, having four points meeting to form the writing point. The illustration, Fig. 45 (18020, 1899), shows a trough formed underneath the nib.

Several inventors have used India rubber in combination with nibs as a means of holding ink. In the first example, Fig. 46 (3808, 1893), a tiny piece of thin sheet rubber is punched

FIG. 44.

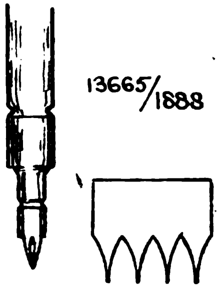


FIG. 45.

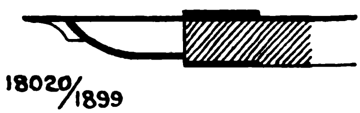


FIG. 46.

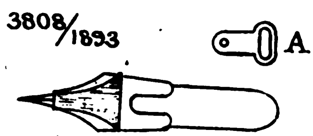


FIG. 47.

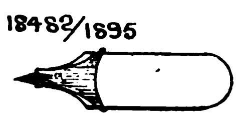
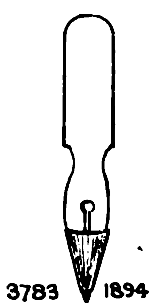
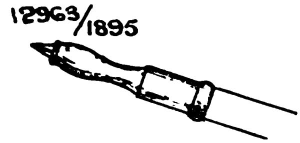


FIG. 48.



out, as shown at A, and this is fitted to the nib by inserting the point into the openings provided. The next example, Fig. 47, is very similar (18482, 1895). In the next illustration, Fig. 48 (3788, 1894), a short piece of india rubber tubing is used; and in the fourth example, Fig. 49 (12963, 1895), a nib, of barrel form, is almost entirely enclosed in a flexible

FIG. 49.



rubber tube, the point of the nib alone being visible.

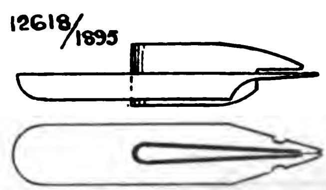
The remaining example, Fig. 50 (7241, 1897) shows a piece of flat rubber, the ends of which are held taut by a metal ring clasping them

FIG. 50.

to the penholder, whilst the point of the nib is just visible through a minute hole in the rubber.

In drawing Fig. 51 (12618, 1895) is shown a nib with an exaggerated "pierce" extending in tapering form about one-half the length

FIG. 51.

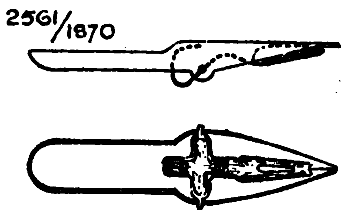


of the nib. Into this perforation is sprung a piece of flat metal, bent like a pair of forceps. It is possible that a considerable quantity of ink might be held here, but the pen is too clumsy to meet with universal approval.

The illustration Fig. 52 (2561, 1870), shows an addition to a nib, having a kind of counterpart pivoted underneath, and held in

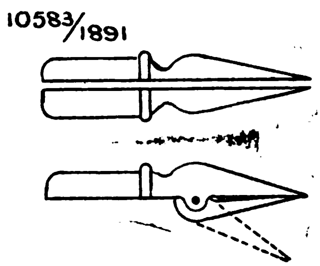
position against the nib by a tail spring. Although patented in 1870, this has recently been offered as a novelty.

FIG. 52.



A more recent patent, Fig. 53 (10583, 1891), is also illustrated here, in which two nibs are held together in a holder, face to face, the

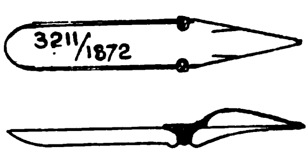
FIG. 53.



cavity forming an ink reservoir; and another drawing shows the lower nib pivoted into the upper one, suggestive of a bird's beak.

In Fig. 54 (3211, 1872) we have a nib which it is convenient to refer to here, although it was not primarily intended for a reservoir nib. The nib proper has no slit, but the combina-

FIG. 54.



tion of its point with the point of the overhanging plate (which, it will be observed, projects slightly beyond the nib point) forms an elastic writing point, the ink being delivered from between the two points, the object being to produce a pen having the sensation of a quill in writing.

The foregoing examples are merely typical, and do not by any means exhaust the number of attempts to produce a reservoir nib. Some of them are very well in their way, and some are ingenious. They obviate the necessity of frequent dippings in the inkpot, for with some of them it is claimed that a letter may be written with one dip of ink.

So far so good, but something more is demanded. A lead pencil may be carried in the pocket, ready for use at any moment, where such an instrument is permissible. The aniline pencil came to meet a want, by supplying a more or less indelible marking agent. Ink, however, was not to be ousted, as, with its drawbacks, it is to-day the most suitable article for writing, a good ink being as permanent (and often more so) as the material upon which it is used. There was room, therefore, for some kind of pen which would carry a supply of ink sufficient to last a considerable time, and yet such a pen as could be carried in the pocket without risk of its being emptied where least wanted.

At this point I leave the subject till next Monday evening, when I shall give an account of the stylographic pen, showing by drawings, its invention, growth and vicissitudes up to the present time.

BRITISH RAILWAYS IN 1904.

The annual report giving the returns of the capital, traffic, receipts, and working expenditure of the railway companies in the United Kingdom* during 1904 has been recently issued by the Board of Trade. In general arrangement this report follows very closely along the lines of its predecessors, so closely in fact that the actual numbers of the pages in the return, in which information concerning specific systems is to be found, are identical with those in previous returns. There is an increase in regard to information published in 1902 in regard to the actual track mileage and length of sidings, and in future issues certain special information relative to electric railways is promised. Regarding all the railways of the United Kingdom as a composite system, the progress during the year is summarised under certain main headings, of which the most important are dealt with below.

Capital.—The total paid-up capital at the end of 1904 was £1,268,500, of which over £193,000,000 (about 15 per cent.) is due to nominal additions through the consolidation, conversion and division of stocks. The increase during the year amounted

* No. Cd. 2523. Wyman and Sons, Limited, Fetter-lane, E.C. Price 1s. 3d.

to £23,500,000, of which £2,300,000 was due to nominal additions. The average dividends paid on the various classes of capital in 1904 were practically the same as in 1903, being 3¼ per cent. on the ordinary capital, 3½ per cent. on the preference, 4 per cent. on the guaranteed, and 3½ per cent. on the debenture stock, while the rate of interest on loans was 4·11 per cent. The mean average dividend on interest on the total capital is 3·42 per cent., but if no nominal additions had been made this would have been 4·03 per cent.

Total Traffic and other Receipts.—The total traffic receipts amounted to £103,787,000 (£55,400,000 from the passenger and £48,387,000 from the goods services), while £8,045,000 was received from rents, tolls, navigation, steamboats, hotels, canals, &c. The traffic increase during 1904 was very small, being 0·9 per cent. from passengers and 0·5 per cent. from goods.

Passenger Traffic.—The items of chief interest are those which show that the receipts from ordinary first-class passengers amounted to £3,429,000 (or £99,000 less than in the preceding year), from ordinary second-class passengers to £3,265,000 (or £67,000 less), from ordinary third-class passengers to £29,382,000 (or £109,000 more). This nett loss on ordinary traffic has been balanced by increased receipts from season ticketholders, a gain of £138,000 towards the total season ticket revenue of £3,999,000; and by increased receipts from the miscellaneous sources of express luggage, mails, parcels, carriages, horses, dogs, &c., which yielded a gain of £338,000 towards a total revenue from these minor sources of £8,322,000.

Season Ticketholders.—Towards actual receipts, the third-class holders of season tickets contributed rather more than three-eighths, for more than half the number of holders, the following Table giving the chief items of interest under this head:—

Class.	Gross receipts.	Number of ticket holders.	Average cost of each ticket.
	£		£ s.
First	1,437,000	130,789	11 0
Second ...	1,038,000	169,272	6 3
Third	1,513,000	343,812	4 8

Goods Traffic.—As regards tonnage carried, the weight of minerals carried increased by 5,900,000 tons to a total of 349,600,000 tons, while general merchandise only increased by 300,000 tons to 100,300,000 tons. The respective revenues earned by these sources amounted to £25,672,000 for minerals, and £28,315,000 for general merchandise.

Working Expenditure.—Despite a decrease in the expenditure on coal for, and general maintenance of, the locomotives used, the working expenditure for 1904 was £610,000 greater than 1903, amounting in all to £69,170,000, or 62 per cent. of the gross receipts. Over one-third of the increase mentioned above is due to rates and taxes, which have increased by £243,000, reaching the huge total of £4,736,000, or more than 4 per cent. of the yearly gross earnings. There is no sign of any diminution of this burden, which in nine years has risen from £3,011,000 to £4,736,000, an increase of over 60 per cent.

THE GERMAN TARIFF.

When in 1875 Prince Bismarck reimposed the corn duties which the German Zoll-Verein abolished in 1865, his primary object was to render the Empire financially independent of the various confederate States. But both then, and since, when the tariff has been raised, it was hoped that it would make the German food supply independent of foreign countries. This aim has not been attained. Probably no one, not even Prince Bismarck, anticipated the enormous increase in the population of Germany that has taken place during the last thirty years. Be that as it may, in the course of the last ten years, Germany has been dependent on foreign supplies for 2·7 to 11 per cent. of her rye consumption, 25·8 to 50·5 per cent. of wheat, 24·5 to 34·3 per cent. of barley, and 1·8 to 9·9 per cent. of oats. The imports have fluctuated in accordance with harvest results, and changes of prices, but there remains a considerable increase. As for the import of cattle and meat, it has been practically stopped by the pressure put upon the Government by the Bund der Landwirthe (Union of Farmers), and under the new tariff, which comes into force on March 1st next, it is hoped to do for corn what has already been done for cattle and meat. It may be interesting to compare the existing tariff per ton of 1,000 kilos with the one coming into force next March:—

	Under existing tariff.	Under new general tariff.	Conventional tariff.	Wholesale price at Berlin per ton of 1000 kilos.
	£ s.	£ s.	£ s.	£ s. d.
Rye	1 15	3 10	2 10	7 2 6
Wheat	1 15	3 15	2 15	8 18 6
Spelt	1 15	3 15	2 15	..
Barley (malting)	1 0	3 10	2 0	8 15 0
„ (other)	1 0	3 10	0 13	7 0 6
Oats	1 8	3 10	2 10	6 18 5

The conventional tariff applies to imports from countries having most-favoured nation treatment.

In the course of the last twenty years, the area under cultivation of cereals and potatoes in Germany has not undergone large changes. As regards wheat and barley, it has remained practically the same. The staple bread stuff—rye, had in 1884 an average of 5,850,000 hectares, which increased to 6,040,000 hectares in 1894, and after falling below 6,000,000 hectares in the following years, and passing it again

in 1902, stood at 6,100,000 hectares in 1904, *i.e.*, about 4 per cent. higher than in 1884. The area in oats shows a larger increase as from 3,780,000 hectares in 1884, to 4,190,000 hectares in 1904, or about 11 per cent. It remains to be seen whether the very much higher tariff, soon to come into operation, will be more successful in its purpose than that now in force. That the agrarian duties have failed to assist the agrarians generally is less surprising when it is remembered that 75 per cent. of all the cultivated land is in the hands of landed proprietors owning estates below five hectares in area. Such owners if they produce corn at all produce it for their own consumption, and the agricultural products which they take to market are of a different kind, such as vegetables, fruit, &c., which yield them a better return. In his report on the trade of Germany for 1904 Mr. Consul-General Oppenheimer has some very interesting observations under this head. He says that the effect of the duty is smallest where it is most required. Corn duties were meant to protect more particularly the small owners, but in fact the effect of the duty varies with the size of the holding and has least effect where it is most wanted. The smaller the farm the greater will be the ratio of home consumption of self-grown corn, whether as food of the family and the farm hands or as food for cattle. Even if these farms sell corn shortly after the harvest they are obliged to buy it back later in the shape of bread, flour, &c., and they are then compelled to pay the price which has been increased by Customs duty, commercial profit, interest, &c. The agrarian and the industrial duties differ considerably in their effect. The larger the percentage of the harvest sold the higher will become the rate of the Customs duty, so that the smaller the landed proprietor the smaller is also the protection he enjoys, and the larger the estate the larger becomes also the protection. With the consumer it is the reverse. The smaller his income the larger is its share which is consumed by bread and flour, and the more acutely does he in consequence feel the weight of the duty. In both cases the duty, according to this argument, presses most heavily on the small man. Nor must it be forgotten that the duties upon fodder, cattle, &c., weigh heavily upon the agrarian. There is hardly an agricultural holding which is not compelled to buy additional fodder for the breeding and fattening of cattle, and stock breeding in Germany being insufficient a considerable number of stock cattle have to be imported from abroad.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in July and August last:—

New Charts.—3506—North sea:—Aussen Jade and and Schillig road. 124—North sea, Netherlands:—Texel. 3516—Norway, west coast:—Nord fiord to Indvik fiord. 3499—Sweden, Norrköping bight:—Landsort to Haradskar. 2362—Sweden:—Landsort to the gulf of Bothnia. 3505—Baltic sea: gulf of Bothnia:—Khögklubb to Goskällen. 33—Germany: Elkernförder Bucht and Kiel fiord. 2714—Portugal, west coast:—Port Setubal. 3482 — Nova Scotia, south-east coast:—Shelburne harbour. 1001—Africa, west coast; plans on the west coast of Africa; plan added:—Dakar. 3030—Bays and anchorages on the south coast of Java; new plan:—Chi Lauteureun bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners:—

No. 1826—England and Scotland, west coasts:—Formby point to Kirkcudbright. 2676—Scotland, west coast:—Loch Alsh and Loch Duich. 1607—England, east coast:—River Thames; North Foreland to the Nore. 2484—England, east coast:—River Thames; London to Gravesend. 1610—England, east coast:—North Foreland to Orfordness. 1491 — England, east coast:—Harwich Harbour. 1543—England, east coast:—Yarmouth and Lowestoft roads. 120—North sea:—River Schelde, from the sea to Antwerp. 2593—Germany:—Ameland to Jade river. 3346—Germany:—Jade and Weser rivers. 2305—Norway, sheet III.:—Stav fiord to Romsdals islands. 3101—Norway:—Atleö to Batalden, including the entrance to Stav fiord. 3118—Norway:—Batalden to Vaagsö. 1145 - Norway:—Vaagsö to Skerpen. 1146—Norway:—Rövde and adjacent fiords. 3038—Norway: — Biörnsund to Kristiansund. 2314—Norway, sheet XII.:—Helgö to Sörö. 2315—Norway, sheet XIII.:—Sörö to North cape. 2316—Norway, sheet XIV.:—North cape to Tana fiord. 2317—Norway, sheet XV.:—Tana fiord to Varanger fiord. 2252—Baltic sea:—Gulf of Bothnia. 3503—Germany, north coast:—Gulf of Danzig, western port. 2835—Black sea:—Delta of the Danube. 517—Central America, east coast:—Porto Bello and the adjacent coast. 2544—South America, east coast:—Rio de la Plata. 1749—South America, east coast: — Monte Video to Buenos Aires. 1325—Chile:—Gulf of Peñas to the Guaytecas islands. 650—Africa, east coast:—Plans on the east coast of Africa—Innambán river, Kilimán river. 1003—Africa, east coast: — Pungue river, Beira harbour. 2599 — Red sea:—Jidda with its approaches. 1419—Andaman islands:—Long island to Port Blair. 2576—Borneo:—Sulu archipelago and the north-east coast of Borneo. 3449—China, east coast:—Amoy, outer harbour. 1798 — China, north coast:—Kwang tung peninsula. 451—Japan:—Yezo island with adjacent straits of Tsugarau, La Perouse, and Yeso. 2411—New Zealand:—Otago harbour, from the entrance to Dunedin. 2540—New Zealand:—Awarua or Bluff harbour.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

Liverpool and Cotton Spinning.—Some short time ago there was a movement in Liverpool to get rid of London as the distributing centre for tea. Many solid arguments were adduced to show that Liverpool would be a considerable gainer by importing direct. Now there is a scheme afloat for the erection of cotton mills at Liverpool. Liverpool merchants say that more and more cotton is going to Manchester which used to come to Liverpool, and that unless the tendency is stopped Liverpool will ultimately lose its cotton import trade altogether, that is to say, the greatest of its commercial interests. It is the old grievance of the Manchester Canal injuring Liverpool trade. The immediate proposal is to spend £1,500,000 sterling in erecting cotton mills at Liverpool with 500,000 spindles. These mills would be the largest and most complete in the world if the intentions of the authors of the scheme were carried out, and all the various operations of spinning, weaving, bleaching, dyeing, and printing would be concentrated at Liverpool. There seems no sufficient reason why Liverpool should not spin cotton as well as import it if it thinks it to its interest to do so, and it is natural it should be of that opinion. It must be annoying to see ships sail by Liverpool with the bales they were formerly in the habit of unshipping there, and if Liverpool cotton mills would stop them from making for Manchester so much the better for Liverpool. There does not seem much in the contention that Liverpool weather is too dry for cotton spinning. Whether the project will ever get beyond the discussion stage remains to be seen. Liverpool is less ready than Manchester for large and costly experiments, but the desire to checkmate Manchester, and the growing appreciation of the risk attached to relying so greatly upon the shipping trade, may carry the scheme to fruition.

The Boot Trade.—Last year, 876,756 pairs of boots were imported into the United Kingdom from the United States. It is an immense number, but in 1901 over a million pairs—to be exact, 1,028,364 pairs—were imported from America, and this year the import is likely to be much less than in 1904. The way in which the British manufacturer pulled himself together in face of American and other competition—in 1901 Belgium sent us 1,192,656 pairs, in 1904 678,828 only—shows that there is a good deal of fight left in him. The American boot manufacturers got a hold in this market by offering a boot no better, perhaps not so good, as the British article from the point of view of durability, but much smarter to look at. The purchaser often prefers appearance to more solid merits, especially when it is combined with cheapness. The British manufacturers met this fresh development of American competition by giving their attention to appearance whilst not neglecting wearing quality. They copied the smartest American models and began to pay great attention to finish and appearance. The result is that they are rapidly recovering the market they lost by ignoring the demand for a good-looking as well as a good wearing boot. Probably there is no trade in the country that now gives better value for money than the boot trade in its cheaper branches, but this can hardly be said of the West-end bootmaker, who adheres to a scale that has little relation to value.

Trade Marks.—A case which should be of interest to traders and patentees in the United Kingdom has recently been decided in the United States Circuit Court in the northern district of New York. It is that of "Siegert *v.* Gardolfi." The plaintiffs sought to restrain the defendants from using the words "Angostura Bitters" as a trade mark. Messrs. Siegert were the original makers of these bitters, and adopted the name of "Aromatic Bitters," but the public generally came to call them by another name, "Angostura Bitters." The question at issue was whether, having registered the trade mark "Aromatic Bitters," which had given place to the unregistered name "Angostura Bitters," Messrs. Siegert had any exclusive right to the use of the better known name. The American court has decided that they have not, that they may not, by adopting the name as their own after other makers have used it to designate their products, obtain any exclusive right to it as a trade mark, or trade name.

Cotton Supplies.—It is much to be regretted that the movement started by the British Cotton Growing Association for promoting the cultivation of suitable qualities of cotton in Britain over-seas is so greatly hampered by lack of capital. The Association was founded under very influential auspices. Its lists of vice-presidents included no less than 22 members of Parliament, and among its supporters were some of the best known names in Lancashire. Moreover the danger of remaining largely dependent upon the United States for the Lancashire cotton supply, a source of supply that is yearly more drawn upon by continental countries and the United States themselves, is so menacing that it was hoped that the funds necessary to give the required impetus to the growth of cotton in British colonies would have been forthcoming. Unfortunately that has not been the case. The abnormal cotton crop of the United States last year, by removing all immediate danger of insufficient supplies of the raw material, deprived the movement of much of the support that might otherwise have been given it, and at present the outlook for the Association, and what is much more important the national work with which it has concerned itself, is anything but hopeful.

Cotton Within the Empire.—It is a little strange that although during the last five and thirty years an

rea of nearly 5,000,000 square miles has been added › the British Empire, a good deal of it quite suitable ›r cotton growing, the quantity of cotton produced ı various parts of the Empire has increased very owly. Fifteen years ago the production amounted ı all to 2,357,304 bales, and in 1903 it had only ıcreased to 2,628,206 bales. More than nine-enths of it comes from India, but the Indian roduction, which was 2,346,121 bales in 1889, as only 2,624,948 bales in 1903. And yet India lone might easily supply the cotton require-ıents of the world. The estimated require-ıents of the cotton spinners of qualities equal to ıe American produce at present, may be put at 1,500,000 bales. A bale contains 500 lbs. of cotton, › that at present the acreage required for cultiva-on is about 28,000,000 acres. The area in the Inited States which can be economically devoted to otton is not thought to be more than 35,000,000 cres, which is small compared with the area that ıight be profitably devoted to the cultivation of otton in India, with its total cultivated area of 26,000,000 acres. Of course, India has its own equirements to meet, but the surplus available for xport might be increased enormously, if only rowers could be induced to cultivate the right ualities. The American crop of the present year bids ıir to reach 11,000,000 bales, and as the Egyptian rop is a record one, and that of India likely to be ear the average, any immediate scarcity is not antici-ated, but that is no good reason for slackening ffort to lessen the present dependence upon the Inited States, although it is to be feared it will have hat effect.

Synthetic Indigo.—The increased sales of synthetic ıdigo bid fair to destroy the old and important Anglo-Indian industry of indigo planting. Since 895-6 the value of the exports has fallen from £3,569,700 to £556,400, and this is largely due to ynthetic indigo. Of the indigo imports of Japan last ear fully three-fourths was the artificial product, vege-able indigo being increasingly unsaleable, in so nuch that some 1,000 cases had to be re-exported. n the United States the synthetic die came on the narket in 1898 and was held at 44 cents. per pound, ıbout the value of vegetable indigo on the indigotine ›asis. Now the price is down to 18 cents., and at his figure it is claimed to be much cheaper than the owest obtainable values in any vegetable indigo. The ırtificial die has already secured nearly 85 per cent. of he world's consumption, and the price of indigo has lropped about one half. The production of synthetic ndigo was known long before it could be produced n a profit-yielding manner. The credit of its dis-covery is due to Germany. The search after the new process of manufacture swallowed enormous sums of money which only wealthy houses could have afforded to spend without any immediate prospect of profit. And a general campaign had to be taken against natural indigo all the world over. The result as it affects the vegetable product is indicated above, and in the fact that to-day Germany imports only small quantities of natural indigo while her exports of synthetic indigo have increased enormously, and represented last year a value of 25,000,000 marks.

A Dwindling Industry.—Although the complaints of cabowners have been loud ever since cabs were first invented for the use of the public, there can be little doubt that the cab industry must be reorganised if it is to retain any measure of prosperity in London. It is said that the metropolitan hansoms are diminishing at the rate of 600 a year, and their shrinkage is likely to continue at an accelerated rate. For the cab has no longer the monopoly which, in the opinion of many, it so greatly abused. The electric tram, the motor omnibus, the tube, the electrified railway, all offer means of locomotion equal, or superior, in point of speed to cab transit, and infinitely cheaper. Even the four-wheeler has to reckon with formidable competition from the railway companies. Whether anything can be done to restore the cab to its old supremacy is doubtful, and the men alienate sympathy by their refusal to accept the taxameter. It may be noted that at a crowded meeting of cab drivers, very representative of the trade, held last week, the men would not even discuss the advisability of accepting the taximeter. Why? Can it harm them unless it harms them by making it impossible to charge an illegal fare? Be that as it may, it seems pretty certain that if the present system of hiring horse and cab to the driver is to be continued the owner will have to accept less than his present demand, and it is worthy of note that in Germany he only receives on an average 7s., as compared with 11s. 3d. in London. Probably the time is not distant when cabs not belonging to great corporations will have to be driven by their owners if they are to be on the streets at all.

Beet Root Acreage.—The acreage in Europe sown to sugar beets must always be the principal factor in determining the price of sugar. The demand for sugar is constantly growing owing to the increase of population, and the higher standard of comfort. On the other hand the area under sugar cane cultivation increases very slowly. There is some slight increase in the cultivation in the British West Indies, and the expansion is more rapid in Cuba, but as compared with the growing requirements of the world, the increase in West Indian production is insignificant. Nor is there any striking increase elsewhere in the acreage under cane. It follows that if sugar is to continue cheap there must be steady and large increase in the area given to beet root cultivation. The following table, prepared by Otto Licht, the well-known sugar statistician, shows the position as it is affected by beet cultivation:—

Season.	Acres.	Season.	Acres.
1880-81	1,976,383	1901-02	4,849,881
1885-86	2,143,154	1902-03	4,415,667
1890-91	3,058,924	1903-04	4,338,892
1895-96	3,311,671	1904-05	3,980,358
1900-01	4,552,014	1905-06	4,643,037

It will be seen that the present year's area is the largest on record with the exception of that of 1901-02, and that it is 662,679 acres larger than that of 1904-05. Coupled with the larger Cuban yield of cane sugar, and average crops elsewhere, it would seem that the requirements of the market will be much better met this year than last.

GENERAL NOTES.

THE CONSUMPTION OF TOBACCO.—Some interesting figures are given by the Bureau of Statistics of the Department of Commerce, United States, respecting the *per capita* consumption of tobacco in recent years. Taking the principal countries of the world it has been as follows:—Belgium, 6·21; United States, 5·40; Germany, 3·44; Austria, 3·02; Canada, 2·74; Australia, 2·59; Hungary, 2·42; France, 2·16; United Kingdom, 1·95; Russia, 1·10; Italy, 1·05. Of course, the cost of the article, and its relation to the purchasing power of the individual consumer, have to be taken into account in noting the wide fluctuations in consumption in various countries. For example, in Belgium, whose consumption is the highest, the tax levied upon tobacco is the smallest of any country in the list. On the other hand, in Italy, where the consumption is the lowest, tobacco is taxed most heavily. Again, while the average consumption of tobacco in the United Kingdom is only 1·95 pounds as against 5·40 in the United States, the revenue raised from tobacco is almost as large in the United Kindom as in the United States. And in taking the *per capita* consumption as shown above, it has to be borne in mind that the majority of the population do not use tobacco at all. Probably not more than a fourth, certainly not more than a third, use it.

JAPANESE SILK.—How largely its leading staple, silk, contributes to the total value of Japanese exports is shown in Mr. Consul-General Hull's report on the trade of Japan, just issued (No. 3502, Annual Series). Taking the exports of Yokohama, which are considerably more than half of the whole country, they amounted in 1904 to the value of £17,355,829, four-fifths of which amounting to close on £14,000,000, belonged to silk. Most of the increase was in raw silk, of which nearly 13,000,000 lbs., of the value of £9,059,000, were exported in 1904, as against under 10,000,000 lbs., value £7,588,000, exported in 1903. The increase in the exports of silk from Japan in 1904 was abnormal, and the explanation must partly be sought in the conditions brought about by the war, which prompted the people to curtail home consumption in favour of foreign trade, with a view to increasing the resources of the country. Thus a considerable quantity of the staple which in former years found a market at home was last year diverted to swell the figures of the export trade. This movement was also largely facilitated by the increasing American consumption which last year absorbed an unprecedented amount of silk. At least two-thirds of the entire export went to America, and about one-half of this was exported by native companies.

PETROLEUM FUEL IN RUSSIA.—Respecting the shortage of petroleum fuel caused by recent events at Baku, the *Board of Trade Journal* reports that the Ministry of Ways of Communication have made over stock in their possession amounting to 4,000,000 pouds to the Volga Navigation Companies. The total shortage of fuel employed by industrial undertakings is estimated by the Ministry of Finance at 50,000,000 pouds, to meet which 90,000,000 pouds of coal are stated to be required. The production of coal in Russia, calculated at 1,000,000,000 pouds, is not, says the Finance Minister, sufficient to meet the increased demand. The Vistula and Baltic State Railways are stated to have decided to acquire 10,000,000 pouds of foreign coal.

THE LATE MR. G. A. THRUPP.—In the notice of the late Mr. G. A. Thrupp, which appeared in the *Journal* for September 8th last, Mr. Thrupp was credited with the foundation of the Coachmakers' Benevolent Institution, of the Institute of British Carriage Manufacturers, and of Technical Schools for Coach Artisans. Although he took a warm interest in all three bodies, the attribution to him of their foundation was hardly correct. The Benevolent Institution was due to a suggestion made by Mr. G. N. Hooper, at a dinner to the Chairman, Mr. J. W. Peters, of a Committee formed in connection with the Paris International Exhibition of 1855. The origination of the Institute of British Carriage Manufacturers was also due to Mr. Hooper's initiative, though Mr. Thrupp was an original member of it. The evening technical classes for coachmakers, founded in 1876, at St. Mark's School-rooms, Oxford-street, were the result of the joint action of Mr. Hooper and Mr. Thrupp, the former gentleman being Chairman of the Committee, and the latter the Honorary Treasurer. Both Mr. Hooper and Mr. Thrupp have done so much to promote the technical education of carriage builders, that it is a matter for regret that any error should have been made in the *Journal*, in attributing undue credit to either of them for their share in an important national work.

l of the Society of Arts.

No. 2,762. VOL. LIII.

FRIDAY, OCTOBER 27, 1905.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

RESERVOIR, FOUNTAIN, AND STYLOGRAPHIC PENS.

By James P. Maginnis,
A.M.Inst.C.E., M.Inst.Mech.E.

Lecture II.—Delivered January 30, 1905.

Stylographic Pens and Manufacture of Gold Pens.

It would appear to be a very simple matter to construct a pen capable of holding a generous supply of ink, especially if one makes it of the stylus form. Nothing perhaps could be more devoid of complications than, say, a glass tube of small diameter, having its one end drawn out to a tapering point, as here shown in Fig. 1. This tube may be filled with ink by placing its point in the liquid and exhausting the air in the tube, when the ink will rise up within it, and, if the opening at the point be sufficiently small, the ink will be held by capillarity in the tube. If the point be now drawn along a sheet of paper, a film of ink will be deposited in the shape of lines, or letters and words. Such a pen is frequently used in recording instruments, where a diagram line is produced automatically; but woe betide him who thinks he is in possession of a fountain pen which he can carry in his pocket and use at will. The laws of nature will assert themselves, and it is more than probable that on the first occasion upon which its proud fashioner and possessor takes it from his pocket to show to his envious friends, he will find that it has completely emptied itself of ink. Then he thinks that a cork or stopper fitted into the upper end would prevent a recurrence of such a mishap. It will, to a limited extent, but the warmth of his body—against which the tube lies—is sufficient to expand the air in the tube, and the ink is forced out through the point by this means. Other details are missing, and I have gone with considerable care into the very many patent specifications so as to be able to show how the ingenuity and skill of many inventors during many years have been applied to find the best solution of the problem as to how a stylographic pen should be designed.

Fig. 1.

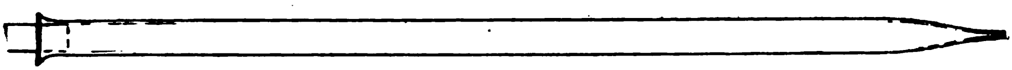


Fig. 2 is a drawing of a pen with a rigid point. It is formed of two pieces of wood carefully fitted and fastened together, having a thin tongue of brass placed between them, with the object of supporting a generous supply of ink. The wood is so formed that the points touch each other, and when the pen is charged with ink or liquid colour, bold lines, of the same width as the pen, may be drawn. In the example illustrated, the lines would be nearly half-an-inch wide. It is also possible to use this pen for bold writing, holding it diagonally,

Fig. 2.

as one would use a "J" pen, with the result that German text hand, or similar lettering, could be produced. With such an unprepossessing instrument, very creditable work can be executed.

A pen for a similar purpose is shown in Fig. 3, the operative part being made entirely of metal. It will be seen to consist of a flat plate at the base, whilst other plates, having their front ends turned downwards, are placed in succession above the flat one. At the back they are soldered together, and fixed in a wooden holder. The three intermediate plates have small perforations in them, and these

FIG. 3.

form a means of communication for the ink to pass from one space to the next, as it is wanted. These pens were introduced by Messrs. E. Wolff and Son, who named them the Auda-script Parcel Pens, and I have used them for at least thirty years, in the preparation of bold drawings, for which purpose they are admirably adapted. They are made of various widths, and lines of corresponding widths may be produced by them.

Fig. 4 is a somewhat similar pen, but of a modified design. It bears the name of a French firm.

FIG. 4.

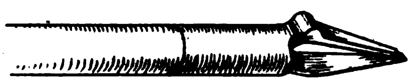


Fig. 5 is yet another of the same type as No. 3, but for fine work only. This bears the well-known name of Perry and Co.

FIG. 5.

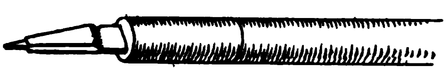
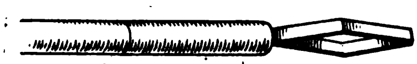


Fig. 6 appears at first glance to be very similar to the previous examples, but it differs in this respect:—The plates at their meeting

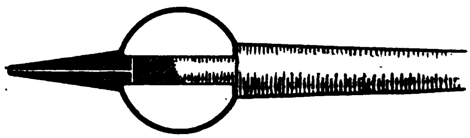
FIG. 6.



point are slightly serrated or grooved, in a graduated manner, so that on filling the pen with a rather thick gummy colour, the lines produced will have a shaded, or graduated effect, regulated by the depth of the serrations. The pen is Stoakes' patent.

A very simple form of pen, Marsh's patent, although not new, but still marketable, is that shown in Fig. 7. It is a self-filling pen. It consists of a tapering wooden holder, having a small bore hole, extending about an inch from the point, and branching off at a right angle, as shown in the section. The black circle represents an india-rubber ball, fitted on the holder as shown. On immersing the point in ink (having previously squeezed the ball and then released it), the ball becomes charged with ink, and the pen may be used for writing on parcels and the like.

FIG. 7.



In March, 1809, a patent (3214) was granted to Messrs. Folsch and Howard for a process enabling the user to produce two or more impressions by one effort in writing. The instrument described is made of glass, enamel, or any sort of stone or metal through which a hole can be drilled. The hole at the point of the pen is very small, but becomes larger a trifling distance therefrom. Common writing ink flowing from the point of the pen will give the first impression; the other copies are obtained by having previously placed alternate sheets of a transfer paper, described in the specification, and sheets of thin writing-paper, under that upon which the original writing was being executed. The pressure of the pen, acting as a stylus, reproduced the writing on the writing-paper, as is customary to-day in many places of business. The interesting feature, however, is that here is a fountain pen of the stylographic type described nearly 100 years ago. It is of the simplest possible form, without valves, needle, or other feed devices, simply a tube tapering at one end to a very fine pipette point.

Thomson's patent (12691) of July, 1849, shown in Fig. 8, consisted of a pen wholly made of glass, in which a piece of capillary tube, A, has a bulb, B, blown upon it at one end, the extremity of the bulb being drawn off into a curved form suitable for the writing point, C, the width of which and the opening

therein determine the thickness of the stroke produced by the instrument when in use. The bulb was filled with ink by suction of the mouth, or by other means of exhaustion. The same inventor also shows in Fig. 9 a piston, K, fitted to a pen of this description, to be used both for supplying ink to the bulb and also for charging the reservoir. The piston slides in a holder, A, and the glass bulb, B, having a short stem, S, is fixed into the holder by a suitable packing.

and soldered or otherwise fastened together at the other end to form a point suitable for use as a style. These wires were slightly separated midway between the ends so as to form a cavity capable of holding a considerable quantity of ink.

The pen shown in Fig. 11 is described by the inventor, H. B. Binks, in 1880 (1359), as being combined with a contrivance for retaining a quantity of liquid ink. It will be seen that it is formed of four wires, A, fixed in a holder, B,

FIG. 8.

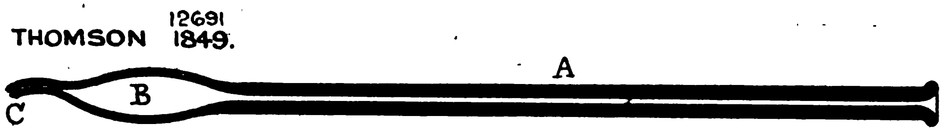


FIG. 9.

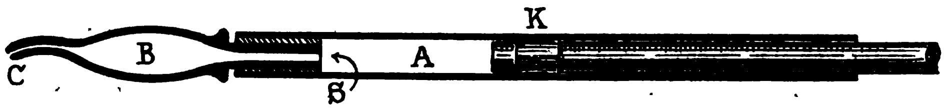
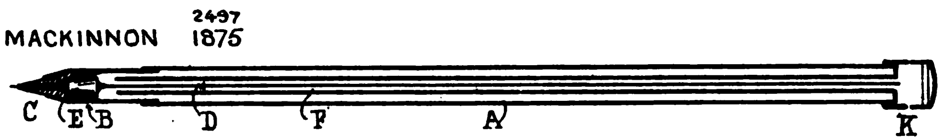


FIG. 10.

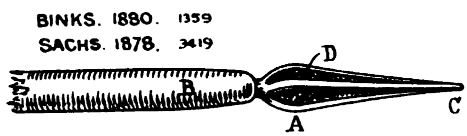


The pen shown in Fig. 10 (2497, Duncan Mackinnon, July, 1875), consists mainly of a tubular ink reservoir, A, closed at its upper end, and terminating in a point holder, B, at the other end. The writing point, C, may be of glass or any other suitable substance. It is bored centrally with a fine hole slightly tapering downwards. A fine wire spindle, D, extends the whole length of the pen, its lower end projecting slightly through the bore of the point, C, into which it fits almost exactly. The spindle, D, carries a weighted valve, E, in such a position that it rests on the seat formed to receive it in the point, C. Pressure on the point of the spindle when writing, will slightly raise the valve, E, and allow ink to pass to the paper. A small diameter dip tube, F, conveys air from the upper end to the ink reservoir. Air openings are provided in the cap, K.

A patent (3419) was obtained by W. Sachs in 1878, for a style formed of a group of four or five wires bound at one end into a holder,

and soldered together at the other end, C, so as to form a writing point suitable for manifold writing or marking. In this respect it is similar to that of Sachs, just described, as patented in 1878. The drawing was made from a

FIG. 11.

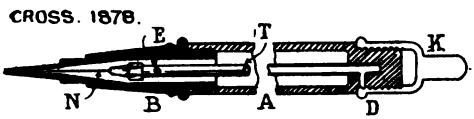


specimen in my own possession, and it is shown as having a bunch of fine wires of metal, glass, or asbestos, inserted in the cavity between the main members of the pen or style.

One of the successful pioneers of stylographic pens was A. T. Cross, who obtained patents (3640 and 4654) in 1879, in Great Britain. Fig. 12 shows a section taken from one of his stylographic pens in my possession, bearing

date 1878, this being probably the year in which his United States patent was applied for. It consists of a tubular reservoir, A, into which a point, section B, is screwed. The needle, N, is attached to the end of a small tube, I, extending the greater length of the reservoir.

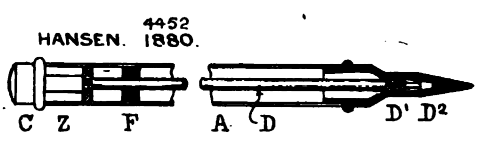
Fig. 12.



This tube admits air from the upper end, D, to a point, E, near where the needle is attached to it. The cap, K, at the end of the reservoir being partially unscrewed, uncovers the small opening leading to the air tube. The needle is not fixed in a rigid manner, but it is free to slide vertically in the box at the end of the tube. This box also contains a minute spring which tends to keep the needle slightly projected through the point of the pen, thus sealing it and preventing any escape of ink. In the action of writing, pressure of the needle upon paper slightly raises it, and in so doing, the ink is permitted to flow. These were amongst the first stylographic pens of a really practical nature, and were introduced into this country by Mr. C. W. Robinson, to whom much credit is due for the popularity of pens of this type. Mr. Robinson claims also to have been the first to suggest the word "Stylographic," as applied to these pens, and he says, Mr. Cross was the first maker to adopt the name.

In Fig. 13, Hansen's patent (4452) of November, 1880, a rod, D, is attached to the cover, C, and passes through the tubular holder, A. The

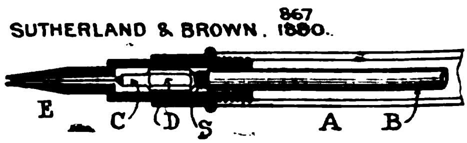
Fig. 13.



rod has an enlarged screwed portion, D¹, which screws into the point section to seal the point, and below this the rod is tapered to form the valve, D². To fill the reservoir the rod, D, is unscrewed and drawn up by the cover, C, and screwed into the socket of the piston, F, which piston is packed with rubber or leather. The piston is then used after the manner of a syringe, first placing the point of the pen in ink, which, by the action of the piston is drawn up into the holder. The rod is then unscrewed from the piston and pushed forward to the position shown. Sometimes the patentee fitted a washer or plate near the upper end of the reservoir to provide a stop to prevent the withdrawal of the piston, and to form an air chamber, Z. An air passage was formed along the rod to the point. Sometimes the rod, D, was made hollow in order to provide an air passage.

Fig. 14 shows a section of the stylographic pen of Sutherland and Brown, of February, 1880 (867). Into the reservoir, A, is screwed the point section, E. An air tube, S, fixed at its upper end, passes down the centre, and carries the needle or style. The latter consists of a fine wire slightly enlarged as shown

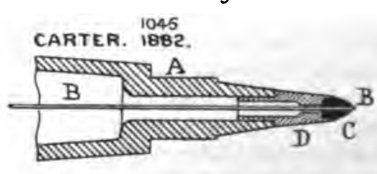
Fig. 14.



at C, where it is formed into a valve, and again at D, where it becomes of polygonal form, thus acting as a guide and a means of keeping the style steady, and permitting the ink to flow from the reservoir along its flat surface. Above this point it enters the air tube, B, freely sliding within it, whilst a light spring, S, tends to keep the valve, C, closed. During the operation of writing, pressure on the point raises this valve and permits the passage of ink.

The point of the stylographic pen is a matter that has had considerable attention bestowed upon it. In March, 1882, J. D. Carter (1045) was granted a patent, and a drawing in his specification is here reproduced in Fig. 15. To

Fig. 15.



render the point more durable he forms it of a jewel, C, mounted in a suitable setting, D, of gold or other incorrodible metal, the setting being burred at its outer end to secure the jewel therein. The jewel, C, is drilled to allow the needle, B, to pass through it, and the setting

D, is fixed in the holder, A, by shrinking the latter around it.

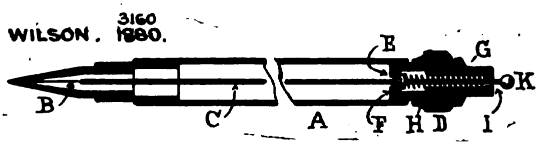
In July, 1880, N. Wilson patented a pen (3160) shown in Fig. 16, which he called the Wilson Stylus, one form of which was made entirely of metal. The construction was very simple. The holder, A, forms the reservoir, and into one end of this is firmly fixed the tapered point, B. A wire rod, C, extends the whole length of the holder, its point reduced in diameter, protruding slightly through the point of the pen. A hollow cap, D, is screwed into the other end, or top of the holder, and in this cap is formed an air chamber, H, and a vent, I, through which the rod, C, passes. A valve, E, formed on the rod, is forced down upon the diaphragm or valve seat, F, by the action of the spring, G, until automatically raised by the pressure upon the point of the pen in the act of writing. The rod, C, may be moved up and down by hand by means of the knob, K, at its upper extremity, for the purpose of clearing the ink duct.

when the cap is slightly unscrewed, and thence through an opening, to the ink reservoir. An aperture is formed in the screwed portion of the point section to allow of the escape of air from the reservoir as the point section is being replaced after filling the reservoir with ink.

In the penholder of J. Nadal, patented June, 1881 (2451), the reservoir is fitted with an air tube to which air is admitted by slightly unscrewing the cap, near the bottom of which there is an opening to admit air to the reservoir. The point section screws into the holder, and has an inner concentric sleeve, to maintain the air tube in a central position. This sleeve is formed with channels to allow the passage of the ink to the point section. A rod is fitted with a disc abutting on the end of the air tube, and with a valve, which by means of a spring prevents the passage of ink to the writing point until it is raised by the act of writing.

Mr. Massey-Mainwaring patented a pen in 1885 (8628), the writing point of which is in the form of a wheel, which rotates in front of the opening from the reservoir, as it is moved along the surface of the paper. This wheel is provided with a circumferential groove, and several radial grooves, which, as the wheel rotates, cause a needle to move up and down, and so produce a constant flow of ink. Such a pen as this must be better adapted for ruling or marking than for writing.

FIG. 16.



The Livermore pen (see Fig. 45, p. 1157), was introduced into this country in 1880 by Mr. Robinson, to whom I have already referred. The slide is taken from a descriptive printed sheet which was issued with the pens by the manufacturers. It will be seen that air is admitted by slightly unscrewing the cap, A, thus permitting the small opening to be uncovered, and allowing air to pass down the central tube to the point, J, where it escapes into the ink reservoir, C. The needle, G, is of gold, and is kept in its forward position by a minute gold spring, hidden within the silver spring box, F. The writing point is fitted with a tiny tube of platinum set in gold.

In the stylographic pen of M. H. Kerner, for which a patent (5733) was obtained in December 1882, the needle is fixed rigidly to the air tube. The air tube is reduced in diameter at the upper end, where it fits tightly in an india-rubber or other elastic washer, fitted in the top of the reservoir. The flexibility of this washer allows sufficient play to the needle in writing. Perforations in the cap admit of the passage of air to the air tube,

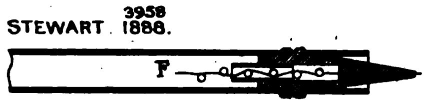
H. Holdsworth, in June, 1885 (7235), introduced a stylographic pen with a gold point, and a tip of ruby. The needle was made of gold wire, with an iridium tip, and was connected to a spiral spring. The inventor describes the top of the pen-holder as being loaded in order to prevent it from falling point downwards if accidentally dropped.

In the stylographic pen of S. A. de Normanville, who obtained a patent (14103) for it in November, 1886, the inner reservoir is elastic. It is closed at the upper end, whilst an ink conducting tube is fitted in the other. The pen or style fits in the tube, and is formed

of two half tubes conical at the writing end. A portion is slotted out to give the requisite elasticity, and also to admit air.

In Fig. 17 is shown a section of the stylographic pen of W. W. Stewart, who obtained a patent (3958) in March, of 1888, the chief novelty lying in his method of delivering ink to the writing point. He says that the

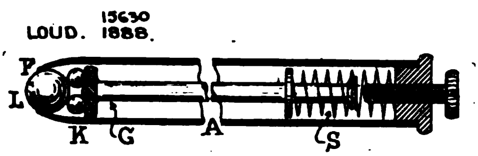
FIG. 17.



stylus may be a bristle, looped as here illustrated, and it will be observed that a bristle or horsehair extends from the writing point into the ink reservoir. This bristle is formed into a series of loops in order the more effectually to retain the ink and prevent a too rapid flow.

The instrument shown in Fig. 18 is not intended for use in writing in the ordinary way. In October of 1888 a patent (15630) was granted to J. J. Loud for the invention of a marking

FIG. 18.



instrument, specially useful for marking boxes or rough surfaces. The drawing shows that it is provided with a movable spheroidal marking point, L, fitting so as to revolve freely in the slightly-contracted mouth, F, of the tube, A. Above this are a number of anti-friction balls, K, held in place by the suitably-formed end of the rod, G, pressed into contact with these balls by the spring, S. A screwed plug, having an air inlet passing down its centre, is screwed firmly down upon the end of the rod, G, when the pen is not in use.

Chambers and Durant, in April, 1888 (5198), obtained a patent for a stylographic pen in which the ink reservoir was made of glass, a substance that would be very suitable for the purpose were it not of so fragile a nature. In Fig. 19, the glass reservoir, A, was a tube pointed at one end, and within this tube was a second tube, B, supported and kept central by two plugs, D and C. Passing through the tube, B, was a wire, E, having a loop, H, at one end and carrying a flexible wire, G, at the other end. In writing, the end, G, projects slightly through the point, and this was capable of adjustment by means of the loop, H, and of the wire, E. To protect the glass tube from injury it was enclosed in a metal casing, and caps, K and L, protected the ends.

Holt's specification (1708) of January, 1889, describes the pen shown in Fig. 20. The style or needle, K, is carried in a hollow spindle, G, which forms a valve at H, in the conical nozzle, C. This nozzle is secured to a plug, B, which screws into the ink reservoir, and is provided with an extension, D, into which screws a plug, F, which serves as a guide to the spindle, G. A spring, L, is placed between F and the collar, I, to press the valve, H, down on its seat. Air is admitted at the upper end through the small tube, N, which is screwed into the plug, M.

A method of obtaining an elastic needle or stylus is shown in Fig. 21, the invention of the before-mentioned Mr. C. W. Robinson, patent No. 3254, of 1890. The general arrangement will be familiar, ink being contained in the reservoir, A. Air is admitted through the small central tube, F, reduced in diameter at G, and attached to this is a short piece of flexible rubber tube, H, with a plug at its extreme end, into which is fixed the needle or style, I. The flexibility of the tube, H, allows the needle to rise, and forces it to fall, in the process of writing. The inventor also suggests that in placing the cap, K, in position, the india rubber plug, D, becomes compressed and forces air in the ink reservoir, and consequently expels ink at the point.

In Wattleworth's patent (2841) of February, 1891, we have a pen, shown in Fig. 22, in which the writing point, B, is made of a solid block of glass, having external longitudinally-arranged grooves along which the ink flows to its extremity. The inventor proposes that the ink reservoir, A, should also be made of glass, and be enclosed in a suitable casing, having a closing plug, C, at one end, whilst the writing point, B, is fitted in the other end. A section of the point, B, is shown also.

Here in Fig. 23 (5861) is another pen having a solid point, the idea of T. Jenks, who patented it in April, 1891. The point, B, takes the form of a grooved pyramid, and is loosely held in place by a metal collar, C, having claws, which permit of a slight vertical movement of the point. A light wire rod, D, is screwed into the point, and as the latter rises and falls the rod also does so, at the same time opening and closing the valve, E.

A nut is provided at L, by means of which the valve may be permanently closed, and the point may then be used as an ordinary style without ink.

Fig. 24 shows a pen with a curious internal economy, the invention of D. Doull, whose specification of April, 1891 (5926), states that to prevent leakage. When the cap is slightly unscrewed, air is admitted through a small hole, Q.

Fig. 25 shows the pen of C. P. J. Fitzsimon, patented August, 1891 (14329). The needle or style, E, extends from the writing point, through the upper end of the ink-holder, A.

Fig. 19.

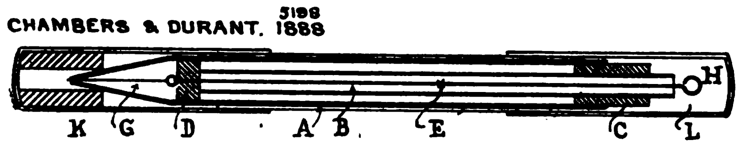


Fig. 20.

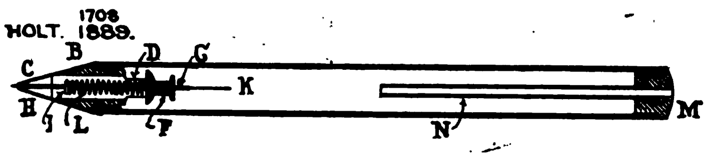


Fig. 21.

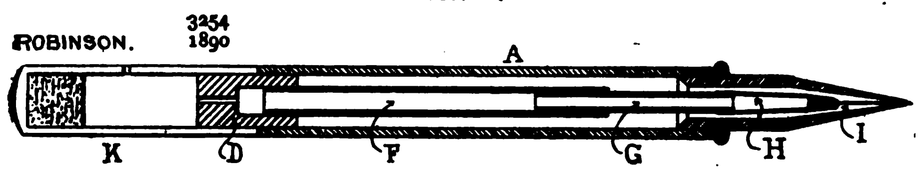


Fig. 22.

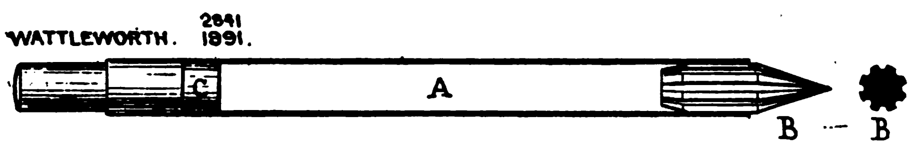
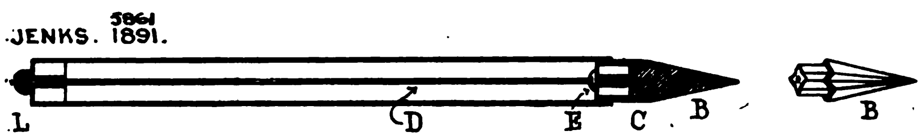


Fig. 23.



the style, D, is forced outwards by a spring, S, the pressure of which is regulated by the thumb screw, E, which actuates a screw-threaded ring, I, working in a threaded portion of the reservoir. The nozzle is shown at C^2, and is slit at the corners to give flexibility in writing. The cap is complex, having an inner part, H, screwing into the reservoir, and has an india-rubber washer, L, Two valves are formed on the needle as at, D, and D^1, which are forced down upon their respective seats by the spring, F, thus normally keeping closed the air passage and also the ink passage from the reservoir to the writing point. The enlargement near the centre of the needle is doubtless intended to act as a means of keeping it steady, and also for adjusting the valves.

FIG. 24.

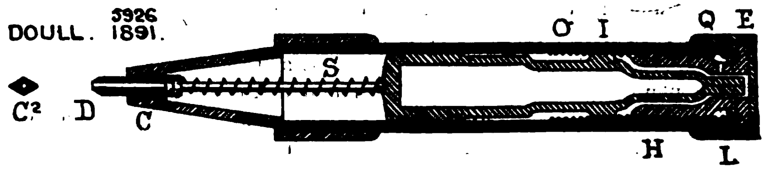
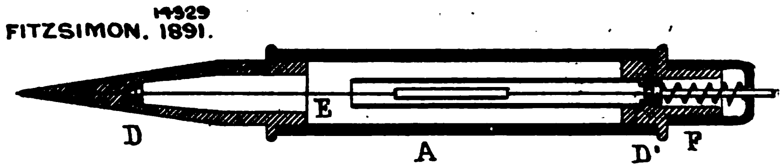


FIG. 25.

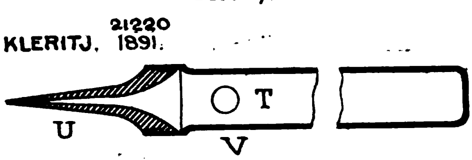


The next patent (19246, 1891) shown in Fig. 26, is that of G. E. Shand, who turned his attention to a detail of some importance in connection with stylographic pens, namely, a trap to prevent the escape of any ink finding its way along the air tube. In this invention, patented November 1891, it will be seen from

FIG. 26.

the section shown, that the pen is formed with an air chamber, B, at its upper end, and a short tube forms the continuation of the air inlet. Should any ink find its way into the air tube, E, it would continue its course to the air chamber, B, and would be prevented from escaping, although air is free to find its way inwards.

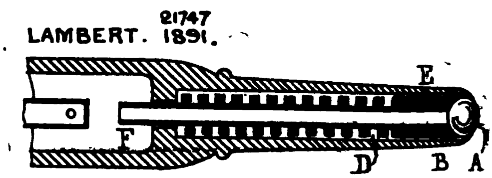
FIG. 27.



The specification of December, 1891 (21220), of L. Kleritj, relates to what he describes as multiple copying implements, useful also as a multiple writer, where fountain pens are used. The drawing, Fig. 27, shows a pen consisting of a tube, T, at the lower end of which is a tapering steel point, U, having a capillary passage. An opening is made at V, for the admission of air. Presumably this opening was covered with the finger in use. No mention is made as to the method of filling the reservoir, and it may perhaps be accomplished by unscrewing the nozzle, or point, U.

Fig. 28 (21747, of 1891) shows a section of E. Lambert's pen, in which a rolling point is used, as in that of Loud. The detail is, however, different, and it is thus described:—The writing point consists of a freely revolving ball, A, partly enclosed

FIG. 28.

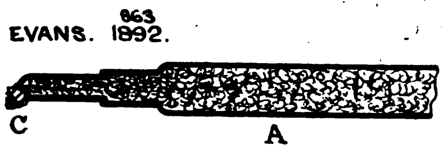


in the holder, B. The ball is kept in place by the bearing, E, of the piece, F, which is pressed against the spring, D. The inventor says that a large-sized instrument may be used for writing on canvas or wood. The ball may be made of vulcanite, or of a metal non-corrodible by ink, and the specification provides for the point containing the ball being in a plane inclined to the longitudinal axis of the pen.

The next pen shown, Fig. 29, the patent of T. Evans of January, 1892 (863), consists of a self-supplying instrument for writing or ruling purposes. As will be seen, the writing point consists of a small wheel or disc, C, pivoted at a convenient angle to the extremity of the holder, A, which latter is filled with an ink-saturated pad. The edge of the wheel, C, is

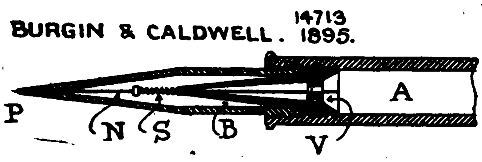
in contact with this, and as the wheel is rotated it picks up enough ink to deliver on the paper. This instrument would probably be more convenient for ruling or drawing lines, than for writing.

FIG. 29.



In Fig. 30, the patent of Burgin and Caldwell, August, 1895 (14713), there is not much that has not already been referred to. It relates to a pen in which the flow of ink is controlled by means of a valve, attached to a spring-held needle. The ink-reservoir, A, terminates in a

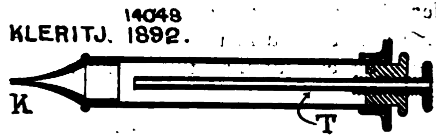
FIG. 30.



conical funnel, B, covered by a valve, V, attached to the needle, N. The free end of the needle projects slightly through the writing point, P. When pressed upon paper, the needle is pushed upwards against the pressure of the spring, S, the valve, V, is raised, and ink passes downwards to the writing point.

The next pen (14048, of 1892), illustrated in Fig. 31, is described by the inventor, L. Kleritj, as a "reservoir penholder suitable for so-called multiple writing machines," meaning thereby machines whereby two or more pens are controlled and operated by the movement of a master pen, by which means a corresponding number of writings may be obtained at one and the same time. Several patents have

FIG. 31.



been obtained for instruments of this kind. The pen in this case has a steel cone or point, K, with a capillary passage and an internal air tube, T. This tube is said to ensure uniformity of pressure, and to permit of the adjustment of such pressure.

Messrs. Mabie, Todd, and Bard have a stylographic pen which they call the "Cygnet." It is here illustrated in Fig. 32, and it will be seen that the needle action is of simple construction, and perhaps resembles that of the Cross pen more than any other. I have recently examined some of these pens carefully, and find they are as beautifully made as are the celebrated "Swan" pens, of which I shall have something to say later in connection with fountain pens.

Another device of A. T. Cross, patented in June 1896 (14093), is here shown in section, in Fig. 33, and in this the needle, N, is attached to a rod, C, having cross arms or guides, G, free to slide in the slots, S, in the ink reservoir, A. An air inlet, I, is formed between the writing point, P, and the point section, J.

FIG. 32.

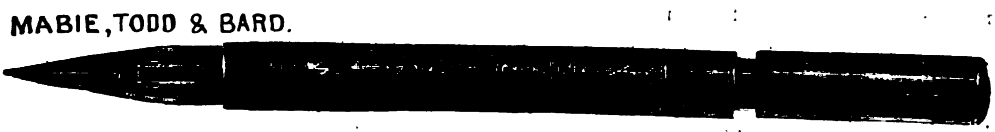
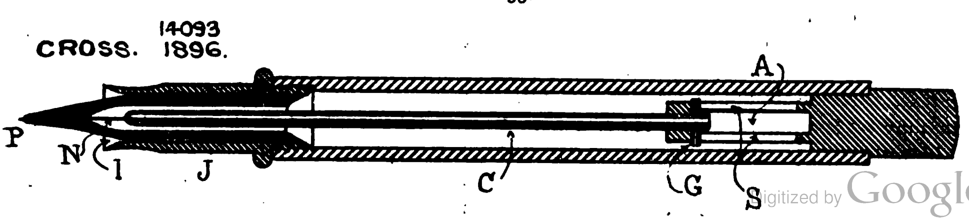


FIG. 33.



The drawing (Fig. 34) shows a pen, partly in section, devised by J. Hardcastle, and patented in June, 1898 (13455). Its principal feature is its self-filling arrangement. The reservoir, A, is fitted with a tubular plunger, C (or piston as the inventor calls it), open at its inner extremity. This plunger slides through a rubber stuffing-box, D. Filling the pen is effected by withdrawing the plunger, ink being thus sucked in through the opening, H. It will be evident that this plunger may be pressed home to the position shown after filling the reservoir, thus keeping the pen of a less unwieldy length than if the plunger were to remain in its extreme outward position.

FIG. 34.

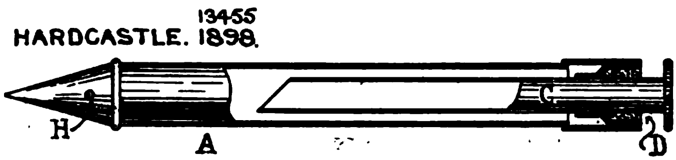


FIG. 35.

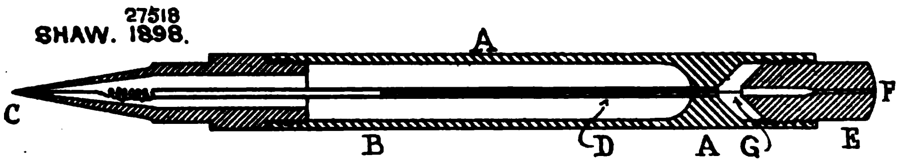
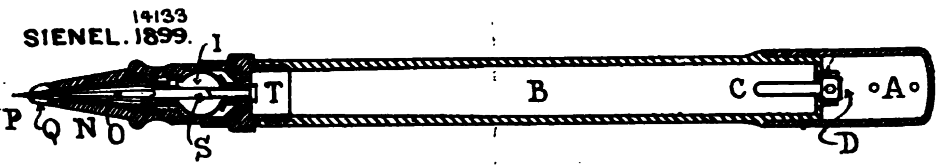


FIG. 36.



In W. T. Shaw's patent specification of December, 1898 (27518), the section shown in Fig. 35 is described. The ink reservoir, B, has a perforated diaphragm, A, into which is fixed the air tube, D. A screw plug, E, fitted into the end of the holder, is pierced with a small hole, F, for the admission of air, and it also carries a fine wire, G, which may be used in clearing ink deposits from the nozzle or writing point, C. Mr. Shaw considers that this principle may be applied to others of his pens. I would add that Mr. Shaw's name is identified with many other useful inventions connected with writing implements and materia Having myself been described as a "schemer," I would pass the compliment to Mr. Shaw, whom I consider to be a schemer of no mean order.

The pen shown in Fig. 36 differs in detail from almost all the others referred to, and is the invention of H. Sienel, July, 1899 (14133). The drawing shows a section of the pen. The writing point, P, is secured to a fluted cone, O, attached to a rod, S, which terminates in a tubular duct, T, to convey ink from the barrel, B, to the rubber ball, I. The conical chamber, N, terminates in the ink cavity, Q, at the point. Air enters through openings in the cap, A, and thence through the valve D, and the tube C, to the ink reservoir, B. The patentee states that the use of this pen tends to prevents writer's cramp.

Messrs. Doull and Doull again appear as the inventors of the new pen shown in Fig. 37 which was patented in June, 1900 (11310). It appears to be somewhat like another pen already referred to, in that the needle, I, owes its flexibility to the fact of its being indirectly attached to the flexible rubber tube, D. The air tube is held steady by the washer, F, through which it passes, and the needle may be adjusted in position, when necessary, by means of the knob A.

The pen shown in Fig. 38 (A. Dittmar, Aug., 1896, 18603), is perhaps unique. It consists of a capillary tube, B, tapering to a writing point, D, and the other end of which dips into the ink reservoir, E. I shall not attempt to describe the advantages to be derived from the use of this pen.

Prof. Dittmar, an electrician, collaborated for some time with Mr. C. W. Robinson, endeavouring to coat gold with iridium, with the object of increasing the durability of the needle it should be delivered very near the writing end of the stylograph. The needle should have just sufficient play or freedom to allow it to rise and fall with the greatest ease, neither more nor less. If this be properly adjusted, then the flow of ink is also as it should be.

An all-important matter in the use of pens of any description is the quality and suitability of the ink used. At home in large towns there is no difficulty in obtaining ink suitable for use in stylographic and fountain

Fig. 37.

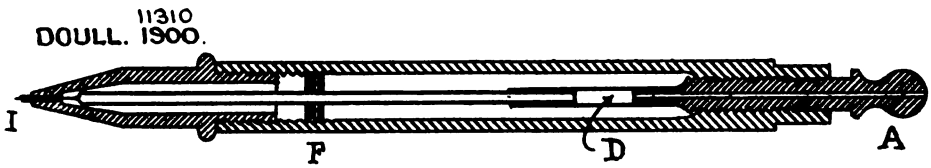
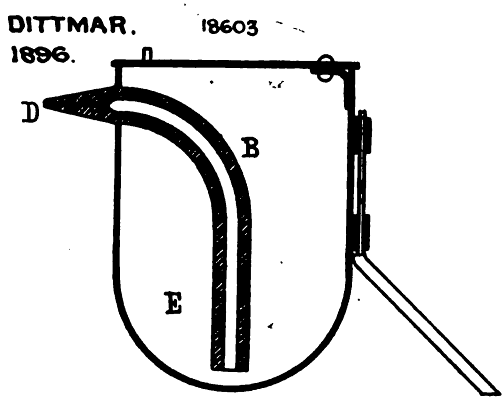


Fig. 38.



of stylographic pens—and with a certain measure of success.

A really good stylographic pen is not by any means to be despised. It has special merits of its own, and there are many persons who prefer it to a "nib" pen. If properly constructed it should permit a regular and even flow of ink when in use. To ensure this, the ink contained in the barrel should be held in perfect equilibrium, and as the ink is withdrawn in writing, the method of admitting air to take its place should be so beautifully designed that just sufficient air and no more be admitted. Experience has proved that it is best to admit air at the top of the barrel, and by means of properly-constructed passages

pens, but travellers abroad, and those who roam, cannot of necessity always procure the right ink just when it is wanted, unless, indeed, they carry a supply with them. It is not the fault of the makers of fountain pens if travellers omit to take this precaution, for suitable ink is offered by the makers, put up in the most convenient form possible. There is, however, an excellent alternative in the form of ink tablets—veritable homœopathic doses of solid ink, one of which is sufficient to charge a pen, the reservoir having been filled with water. These, in my opinion, add one more point, if such be needed, to the convenience afforded to those who carry a fountain or stylographic pen.

STYLOGRAPHIC PENS OF TO-DAY.

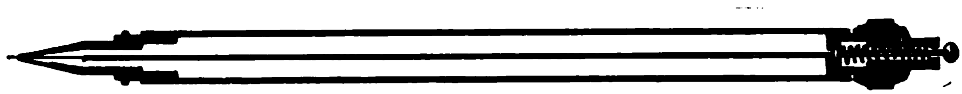
The invention of the vibrating needle-pointed pen introduced a revolution in the mode of writing, far more perhaps, than did the invention of steel or gold nibs. The great novelty and innovation on the then customary mode of writing, and their necessarily high cost when first introduced, stood very much in the way of their immediate acceptance as writing implements. As compared with the fountain pen (with its nib) the advantages claimed are, that it is much cheaper, and that the film of ink it distributes on the paper is so thin that it dries almost immediately. It is not, strictly speaking, a pen at all, but it has been more truly described as a fluid pencil, and the sensation of writing with a stylographic pen is very similar to that experienced when using a pencil. When properly adjusted it glides along smoothly and noiselessly, but in use the characteristic of one's handwriting is naturally more or less lost.

I have hitherto referred to stylographic pens in chronological order, that being the most convenient method for this lecture. There still remain a few which I have not yet described, which deserve a prominent place, on account of their excellence. These will be recognised in the following slides, which were photographed from a series of drawings I prepared some time ago to illustrate leading types of stylographic pens, and this fact accounts for a slight repetition of some of those already described.

The Wilson stylus, a complete section of which is shown in Fig. 39 has already been described (p. 1149), but a drawing of it happened to be included in this slide. It was made in vulcanite, as well as in metal, and I have some examples of these pens in both materials given me by their inventor. Those in metal are either nickel plated or gilt, and are objectionable on account of their weight, which is considerable for a pen. The inventor, however, Mr. N. Wilson, partner of the well-known firm of Wheeler and Wilson, deserves credit in that he set himself to produce a practical pen at a low price, and this he succeeded in doing, as his pens were sold in 1880 at half-a-crown each. One could not rely on them as pocket pens, for they soon acquired an unpleasant habit of leaking. Furthermore, the points were too soft and soon wore out.

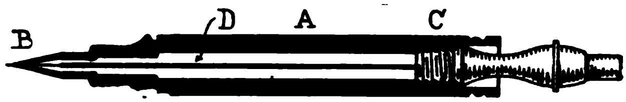
A provisional patent (3305), for the pen

FIG. 39.



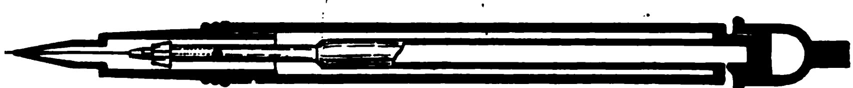
The Wilson Stylus 1880

FIG. 40.



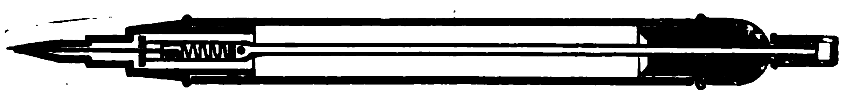
Kuttner's patent 1881

FIG. 41.



The Cross. 1878

FIG. 42.



Perry & Co's Styloidograph. 1879-1880

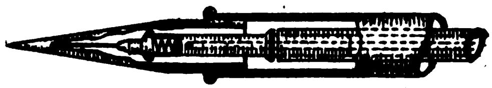
shown in Fig. 40 was obtained by J. Kuttner in July, 1881. This pen consisted of two parts only, and the section here shown in taken from an actual example in my possession. The reservoir, A, terminates in the usual manner, in a tapering writing point, B. An adjustable screw plug, C, screws into the other end of A, and forms a valve which may be opened or closed by screwing the plug out or in. A wire, D, of metal, and of uniform diameter hroughout, except at the extreme point, is ixed firmly in the plug C, and is just long enough to reach the point passing through a ninute parallel hole. In the act of writing, his wire vibrates to an extent controlled by he distance it protrudes through the writing point, this being regulated by the plug C, which simultaneously regulates the air supply o the ink reservoir. This pen point was, like hat of the Wilson stylus, too soft, and did not ast long.

In Fig. 41 is another drawing of the Cross pen, which has already been fully described (p. 1147), and I have nothing to add except, perhaps, to give the pen a word of commendation, in that one of these served me well for many years, and was only cast aside as a result of an accident.

About 1879 or 1880, Messrs. Perry and Co. ntroduced a very handsome-looking stylo-pen, which they called the "Styloidograph," and which is shown in section in Fig. 42. It was very similar in construction to the Cross pen, Fig. 42, having an air tube extending from the extreme upper end, and terminating in a spring box containing a piston or plunger to which the needle was attached. The barrel or reservoir was of richly-chased vulcanite, and the plug and cap, as well as the point section, were of gilt metal, presenting a smart appearance, which did not detract from its effective working.

Fig. 43 is a section of the point of a pen, advertised by Messrs. Burge, Warren and Ridgley as the "British Stylographic Pen," working on much the same principal as that of Cross. It will be noticed that the air tube is telescopic, thus forming a ready means of adjusting the position of the needle.

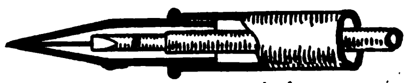
FIG. 43.



The British Stylographic.

In Fig. 44 the writing point of the stylograph known as the "Independent" is shown in section. The needle in this case is fixed rigidly in the end of the air tube, relying on its own flexibility for freedom in writing.

FIG. 44.

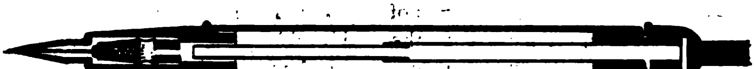


The Independent.

Mr. C. W. Robinson has a metal pen, made in 1868 by himself, in which the rigid needle is used as here illustrated.

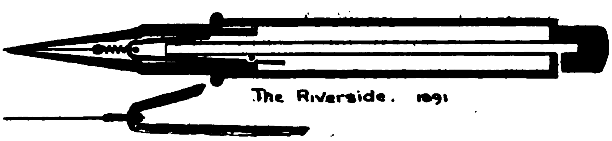
The "Livermore," has already been referred to on p. 1149. It is shown in section in Fig. 45, and it will be seen that the box carrying the spring, and the plunger to which the needle is attached, is a fixture in the point section into which it is screwed, and is not attached to the air tube as in previous examples. It was in its day a very excellent pen, but it is now seldom seen. One of these pens, which I carried regularly for some years away back in the early eighties,

FIG. 45.



The Livermore 1882

FIG. 46.



The Riverside. 1891

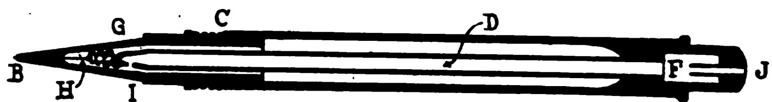
only failed as the result of falling on a railway platform some twenty years ago. This pen has now been repaired and is in perfect working order.

Fig. 46 shows a section of the "Riverside" pen. One of the advantages claimed for this pen lies in the method of holding the needle. A flat strip of silver is bent into the form shown below the pen, and passing through a hole in the fold is placed the needle, free to rise and fall with the spring. This combination is pushed into the point section, where it is held steadily by the effort of the silver strip, or yoke (as it is called), to expand, and the needle may readily be adjusted by raising or lowering the yoke as required. Although this ingenious little arrangement is here associated with the "Riverside" pen, I am under the impression that it is the invention of a Mr. Brown, whose name is well-known as the inventor of a fountain pen which I shall refer to in my next lecture. The "Riverside" pen is one of the specialties of the London Pen Company, founded by Mr. C. W. Robinson.

De La Rue's Stylograph.—This consists of the usual number of parts, viz., the cap, the point section, and the barrel, as shown in section in Fig. 47. The cap is similar to the caps of fountain pens, but is provided with a small pad or cushion of india-rubber, the object of which is that of a safeguard to prevent any possible leakage of ink from the point when the cap is in position. The point section is formed as shown, terminating in a tapering point, which again terminates in a very small metal tube skilfully inserted therein. The barrel is a vulcanite cylinder or tube into one end of which the point section screws, as shown at C, whilst into the other end (which is practically solid) is fitted a vulcanite tube, D, of small diameter, extending the entire length of the barrel. The end of this tube is open to the outer atmosphere through the chamber, F, and the hole, J; its other end, G, is sealed, and terminates in a short solid spindle upon which is fixed a coiled wire, extending forward in a straight line as shown at B. This wire is of such a diameter and length as to pass freely through the point, and just protrudes beyond B, when the point section is screwed home. One can readily recognise here the invention of Mr. Shaw of 1898, already described. Close to the sealed end G, of the air tube, there is a small hole I, which establishes communication between the interior of the air tube D and the barrel.

The pen being filled the ink runs down into the very restricted annular space between the wire, H, and the point, B, and thence on to the paper. At the same time air is being admitted through the chamber, F, and the air tube, D, to the opening, I, whence it bubbles up through the body of ink. In the chamber, F, is fixed a short tube open to the outer air at J. This tube forms an effective trap, as previously described, preventing the ink from leaking through the air vent, J, should a drop happen to find its way there, in case the pen be held in an inverted position.

FIG. 47.



The Nota Bene.

Altogether this is a very beautifully made instrument and one that I use continually for writing in manifold, I therefore speak from a practical experience extending over a considerable period.

I believe this pen is now called the "Pelican" Stylograph, by Messrs. De la Rue, the manufacturers of it, and as I have seen it being made I can testify to the great care exercised in its production.

Having now concluded my notes on Stylographic Pens, I should like to be permitted to assure those who have so attentively listened to me that I have throughout endeavoured to obtain the most reliable information on the various details described, and I have received very valuable help from gentlemen interested in the industry, as well as from Mrs. Robinson, to whose husband I have referred more than once this evening. It is more than probable, however, that errors may have found their way into my descriptions, in which case I shall be glad to be corrected, and to rectify any such errors. As I intimated last Monday evening I am not here to advocate any pen, but simply with a view to place on record what has been

done by busy inventors and workers to produce a satisfactory writing implement.

I now pass on to say a few words about gold pens and their manufacture.

To adapt the quill pen to modern requirements, as a writing implement, is impossible. In use, it has charms which kept it in favour for a very long time, but the disadvantages are great. It needs continual repair and attention, and it is not given to all to make a passable quill pen. Its life is limited. It soon wears out.

The steel pen is a great stride in advance of the quill. But a steel pen has serious drawbacks. The best steel pen will be quickly corroded by the acid found in many of our inks, or it will oxydize, and many a steel pen has to be discarded through one or other of these causes just as the writer is beginning to congratulate himself that at last he has a smooth-running pen with which he can write in comfort.

True, pens are frequently made of metals other than steel—alloys not so liable to corrosion. To meet the requirements of a good pen, such a metal must be flexible, durable, and proof against the action of corrosion and acid, and experience has proved that gold is the only metal which meets the case. It is, however, not pure gold, but is alloyed with silver, and thus reduced to 14-carat quality. This is almost universally adopted as the correct standard of fineness. There is another supreme quality required which the gold does not possess in a sufficient degree, and to obviate this defect the exceedingly hard metal iridium is called into service. The high price of iridium prohibits its use in making the complete pen of that metal; but it is recorded that about the year 1822 an English engineer, John Isaac Hawkins, discovered the advantage of attaching a fragment of iridium to the point of a gold pen, placing it in such a position on the point that it was the only part of the pen coming into contact with the paper in the process of writing. Iridium still continues to be the characteristic feature of all the best gold pens, though since Mr. Hawkins' time many improvements have been made in the methods of manufacture. Mr. Hawkins conducted a long series of experiments with a view to arrive at the best material to use. He tried rubies for the purpose, but these did not prove satisfactory. He cemented diamond dust to the points of quill pens, with even less satisfactory results.

It appears that after some thirty years of experiment, Mr. Hawkins heard of the failure of a pen-maker (Mr. Robinson) to make a pen of iridium, which he found too hard to work into shape. This fact encouraged Mr. Hawkins to give iridium a trial. The excessive hardness of the metal appealed to him, and in a simple manner he overcame the trouble. A very high speed lathe solved the problem. Using diamond dust and oil on a disc running at a very rapid rate, he found that he could cut into iridium, but even then very slowly, for a ruby could be cut in about one-third of the time. If then, iridium was say three times as hard as the ruby, he felt he had arrived at the right substance to give an absolutely durable pen point. But iridium was scarce. There was only one dealer in London at that time from whom it could be procured, and his stock was so small as to become quickly exhausted. However, there was sufficient of the precious metal to form points for a number of pens.

Thus the honour of originating the present and almost universal type of gold pen belongs to England, a trivial matter it may seem, but it has grown into an extensive industry.

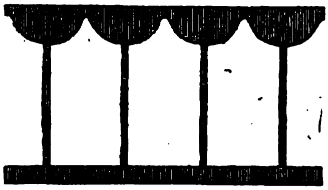
It remained for our American friends to invent various labour-saving machines and devices for the production of gold pens, and although a large number are manufactured in England, it is said that New York practically supplies the bulk of the gold pens used throughout the world.

By the courtesy and kindness of Mr. Evelyn De la Rue I have recently had the opportunity of seeing gold pens manufactured in the works in Bunhill-row. I have also been given valuable information on this subject by Mr. Watts, the London representative of the well-known firm, Messrs. Mabie, Todd and Co., of New York, and I propose using by way of illustration, some slides prepared from woodcuts with which Mr. Watts has been good enough to supply me. Without going into minute detail I would give a sketch of the various phases assumed during the process of manufacture:—

Ingot of Gold.—Beginning with the brick or ingot of pure gold, the first step, of course, is to alloy this with silver and copper to a fineness of 14 carats. The alloy is melted and remelted to ensure uniformity, and is then cast into ingot form. The ingots are then rolled into ribbons, of a width and thickness suitable for the particular kind, or size, of pen to be afterwards made from it.

Fly Press.—These ribbons are fed by hand into a fly press, the die and matrix of which, formed to the exact outline required, relentlessly cut or stamp out the "blanks" one after

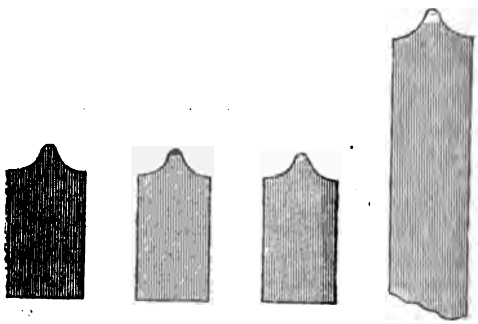
FIG. 48.



another as the operator swings the handle of the press, leaving the ribbon of gold as here shown, in Fig. 48. This is the birth of the gold pen, and its appearance coincides with the orifice formed in the ribbon.

Pen Blanks.—The "blank," as it is called, is shown in Fig. 49 at C. It is, of course, a flat piece of gold, and does not from its general form look like a promising writing implement, but it is ready to have its iridium point applied, and to this end the blank is first hollowed out on one side of the point as shown at D, to receive two carefully selected particles of the hard and costly iridium, which the workman,

FIG. 49.

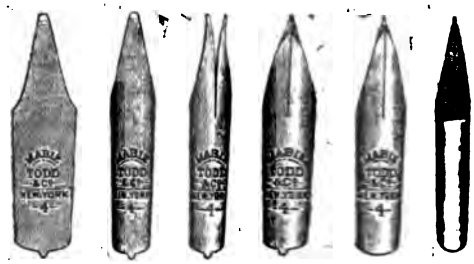


C D E F

by the aid of a strong magnifying glass, applies to the tip of the point. With a blowpipe flame the gold is fused around the iridium, and holds the grains firmly in place. This leaves the blank in the condition indicated at E, and is ready for the next process, which consists in passing it between rollers under a great pressure, which has the effect of elongating it considerably, as shown at F. The point is not touched, and the amount of rolling is regulated by the degree of elasticity required in the finished pen. Tempering is attained by the action of a steam-hammer, which also solidifies the gold and improves its elasticity.

Gold Nibs.—The blank is now cut a second time by means of punch and die, when it assumes more of the appearance of a finished pen, except that it is still flat, as at G. (Fig. 50). It also has embossed or stamped upon it the maker's name or some distinguishing device, and the point—which is still clumsy and thicker than the other part, as it has not been rolled—is carefully ground away with emery and oil until the iridium particles are exposed. The blank is now ready for raising or shaping into the curvilinear form shown at H, so familiar in pens, and this is done by a blow from a die of the correct shape, which presses the pen

FIG. 50.



G H I J K L

into form between its surface and that of a counter-die. Slitting is next accomplished by means of a thin disc of soft copper revolving at a very high speed, its periphery dipping into a reservoir of very fine emery and water and the action of this disc as a cutting tool is so positive that not even iridium can withstand it. The pen now, as seen at I, is not just the instrument one would select to write with. To reduce it to proper form, it is placed in a kind of holder, which firmly grips it right up to the root of the slit, and the sawn edges of the slit are carefully ground, polished on a thin iron disc revolving in oil and emery, and it requires all the skill of an experienced workman to make these edges exactly true and alike. This being done, as at J, K, the points are just as carefully ground, and the nibs are set in their familiar position. The setting must be properly done, as if one nib of the pen should be thicker or thinner than the other, or if one should not be an exact counterpart of the other, the pen will be useless. The last process is to roughen slightly the underside of the pen point, and thus enable it to hold the ink. This is done by the action

of the sand blast. The result of this is indicated at L, and his "nib-ship" is complete.

It may be of passing interest to state that, at the works of Messrs. De la Rue the workmen employed in making the gold pens are required to wash their hands and faces before leaving the premises, with the result that something like £150 to £200 worth of gold is recovered, per annum, and it is stated that in the works of the Waterman Pen Company, in the United States, a similar rule is enforced, producing about 90 dols. worth of gold each month. The clothing worn by the operators is the property of their employers, who burn the garments to ashes for the sake of the gold-dust they carry.

The gold nib has become the universal writing point of the fountain pen. The gold, as I have already stated, is used because of its non-liability to oxydise; and iridium is adopted because of its extreme hardness, which renders it peculiarly suitable to resist wear due to friction, as it glides over the surface of the paper. Gold pens may be had in every degree of flexibility, either with fine or broad point, and cut to any angle, so as to suit the requirements of the most fastidious, and the most exacting scribe.

Here I leave the subject till next week, when I intend to devote the whole of the time at my disposal to an account of the invention and perfecting of the Fountain Pen.

IRRIGATION IN EGYPT.*

Irrigation may be defined as the artificial application of water to the purposes of agriculture. It is, then, precisely the opposite of drainage, which is the artificial removal of water from lands which have become saturated, to the detriment of agriculture. A drain, like a river, goes on increasing as affluents join it. An irrigation channel goes on diminishing as water is drawn off it. Later on I shall show you how good irrigation should always be accompanied by drainage.

In lands where there is abundant rainfall, and where it falls at the right season of the year for the crop which it is intended to raise, there is evidently no need of irrigation. But it often happens that the soil and the climate are adapted for the cultivation of a more valuable crop than that which is actually raised, because the rain does not fall just when it is wanted, and there we must take to artificial measures.

In other lands there is so little rain that it is practically valueless for agriculture, and there are but two alternatives—irrigation or desert. It is in countries like these that irrigation has its highest triumph; nor are such lands always to be pitied or despised. The rainfall in Cairo is on an average 1·4 inch per annum, yet lands purely agricultural are sold in the neighbourhood as high as £150 an acre.

This denotes a fertility perhaps unequalled in the case of any cultivation depending on rain alone, and this in spite of the fact that the Egyptian cultivator is in many respects very backward. The explanation is not far to seek. All rivers in flood carry much more than water. Some carry alluvial matter. Some carry fine sand. Generally the deposit is a mixture of the two. I have never heard of any river that approached the Nile in the fertilising nature of the matter borne on its annual floods; with the result that the plains of Egypt have gone on through all ages, with the very minimum of help from foreign manures, yielding magnificent crops and never losing their fertility. Other rivers bring down little but barren sand, and any means of keeping it off the fields should be employed.

Irrigation in Egypt.—No lecture on irrigation would be complete without describing what has been done in Egypt. You are generally familiar with the shape of that famous little country. Egypt proper extends northwards from a point in the Nile about 780 miles above Cairo—a long valley, never eight miles wide, sometimes not half a mile. East and west of this lies a country broken into hills and valleys, wild crags, level stretches, but everywhere absolutely sterile, dry sand and rock, at such a level that the Nile flood has never reached it to cover its nakedness with fertile deposit. A few miles north of Cairo the river bifurcates, and its two branches flow each for about 130 miles to the sea. As you are probably aware, with rivers in a deltaic state the tendency is for the slope of the country to be away from the river, and not towards it. In the Nile Valley the river banks are higher than the more distant lands. From an early period, embankments were formed along each side of the river, high enough not to be topped by the highest flood. At right angles to these river embankments others were constructed, dividing the whole valley into a series of oblongs, surrounded on three sides by embankments, on the fourth by the desert heights. These oblong areas vary from about 50,000 to 3,000 acres. I have said the slope of the valley is away from the river. It is easy, then, when the Nile is low, to cut short deep canals in the river banks, which fill as the river rises and carry the precious mud-charged water into these great flats. There the water remains for a month or more, some three or four feet deep, depositing its mud, and then at the end of the flood it may either be run off direct into the receding river, or cuts may be made in the cross embankments and the water passed off one flat after another, and finally rejoin the river This takes place in November, when the river is rapidly falling. Whenever the flats are firm enough

* Extract from the Address of Sir C. Scott Moncrieff, K.C.S.I., K.C.M.G., President of the Engineering Section British Association at Johannesburg on August 28.

to allow a man to walk over them with a pair of bullocks, the mud is roughly turned over with a wooden plough, or even the branch of a tree, and wheat or barley is immediately sown. So soaked is the soil after the flood that the seed germinates, sprouts, and ripens in April without a drop of rain or any more irrigation, except what, perhaps, the owner may give from a shallow well dug in the field. In this manner was Egypt irrigated up to about a century ago. The high river banks which the flood could not cover were irrigated directly from the river, the water being raised as I have already described.

The Barrage.—With the last century, however, appeared a very striking figure in Egyptian history, Muhammed Ali Pasha, who came from Turkey a plain captain of infantry, and before many years had made himself master of the country, yielding only a very nominal respect to his suzerain lord, the Sultan, at Constantinople.

Muhammed Ali soon recognised that with this flood system of irrigation only one cereal crop was raised in the year, while with such a climate and such a soil, with a teeming population and with the markets of Europe so near, something far more valuable might be raised. Cotton and sugar-cane would fetch far higher prices; but they could only be grown at a season when the Nile is low, and they must be watered at all seasons. The water-surface at low Nile is about 25 feet below the flood-surface, or more than 20 feet below the level of the country. A canal, then, running 12 feet deep in the flood would have its bed 13 feet above the low-water surface. Muhammed Ali ordered the canals in Lower Egypt to be deepened; but this was an enormous labour, and as they were badly laid out and graded they became full of mud during the flood and required to be dug out afresh. Muhammed Ali was then advised to raise the water surface by erecting a dam (or, as the French called it, a barrage) across the apex of the delta, twelve miles north of Cairo, and the result was a very costly and imposing work, which it took long years and untold wealth to construct, and which was no sooner finished than it was condemned as useless.

Egyptian Irrigation since the English Occupation.—With the English occupation in 1883 came some English engineers from India, who, supported by the strong arm of Lord Cromer, soon changed the situation. The first object of their attention was the barrage at the head of the delta, which was made thoroughly sound in six years and capable of holding up 15 feet of water. Three great canals were taken from above it, from which a network of branches are taken, irrigating the province to the left of the western or Rosetta branch of the river, the two provinces between the branches, and the two to the right of the eastern, or Damietta branch.

In Upper Egypt, with one very important exception (the Ibrahimieh Canal, which is a perennial one), the early flood system of irrigation, yielding one crop a year, prevailed until very recently, but it was immensely improved after the British occupation by the addition of a great number of masonry head sluices, aqueducts, escape weirs, &c., on which some £800,000 was spent. With the completion of these works, and of a complete system of drainage, to be alluded to further on, it may be considered that the irrigation system of Egypt was put on a very satisfactory basis. There was not much more left to do, unless the volume of water at disposal could be increased.

Probably no large river in the world is so regular as the Nile in its periods of low supply and of flood. It rises steadily in June, July, and August. Then it begins to go down, at first rapidly, then slowly, till the following June. It is never a month before its time, never a month behind. It is subject to no exception floods from June to June. Where it enters Egypt the difference between maximum and minimum Nile is about 25 feet. If it rises $3\frac{1}{2}$ feet higher, the country is in danger of serious flooding. If its rise is 6 feet short of the average, there existed in former days a great risk that the floods would never cover the great flats of Upper Egypt, and thus the ground would remain as hard as stone, and sowing in November would be impossible. Fortunately the good work of the last twenty years very much diminishes this danger.

The Assuan Dam Reservoir.—In average years the volume of water flowing past Cairo in September is from thirty-five to forty times the volume in June. Far the greater part of this flood flows out to the sea useless. How to catch and store this supply for use the following May and June was a problem early pressed on the English engineers in Egypt.

During the time of the highest flood the Nile carries along with it an immense amount of alluvial matter, and when it was first proposed to store the flood-water the danger seemed to be that the reservoir would in a few years be filled with deposit, as those I have described in India. Fortunately it was found that after November the water was fairly clear, and that if a commencement were made even as late as that there would still be water enough capable of being stored to do enormous benefit to the irrigation.

A site for a great dam was discovered at Assuan, 600 miles south of Cairo, where a dyke of granite rock crosses the valley fo the river, occasioning what is known as the First Cataract. On this ridge of granite a stupendous work has now been created. A great wall of granite 6,400 feet long has been thrown across the valley, 23 feet thick at the crest, 82 feet at the base. Its height above the rock-bed of the river is 130 feet. This great wall or dam holds up a depth of 66 feet of water, which forms a lake of more than 100 miles in length up the Nile Valley, containing 38,000 million cubic feet of water.

The dam is pierced with 180 sluices, or openings, through which the whole Nile flood, about 360,000 cubic feet per second, is discharged. A flight of four locks, each 260 by 30 feet, allows of free navigation past the dam. The foundation-stone of this great work was laid in February 1899, and it was com-

pleted in less than four years. At the same time a very important dam of the pattern of the barrage north of Cairo was built across the Nile at Assiut, just below the head of the Ibrahimieh Canal, not with the object of storing water, but to enable a requisite supply at all times to be sent down that canal.

The chief use of the great Assuan reservoir is to enable perennial irrigation, such as exists in Lower Egypt, to be substituted in Upper Egypt for the basin system of watering the land only through the Nile flood; that is, to enable two crops to be grown instead of one every year, and to enable cotton and sugar-cane to take the place of wheat and barley. But a great deal more had to be done in order to obtain the full beneficial result of the work. About 450,000 acres of basin irrigation are now being adapted for perennial irrigation. Many new canals have had to be dug, others to be deepened. Many new masonry works have had to be built. It is probable the works will be finished in 1908. There will then have been spent on the great dam at Assuan, the minor one at Assiut, and the new canals of distribution in Upper Egypt, about six and a half millions sterling. For this sum the increase of land rental will be about £2,637,000, and its sale value will be increased by about £26,570,000.

INSANITY.

The Report of the Lunacy Commissioners just issued hardly supports the common opinion that insanity is largely on the increase in England and Wales. It is true that on the 1st of January, 1905, the ratio for the insane per 10,000 of population was 35·09 as against 34·71 for the same day of 1904, the actual numerical increase of the insane having increased from 117,199 to 119,829, say 2,630, or 2·2 per cent. But this is a lower increase than in any year since 1901, when it was only 1,333. In 1899 it was 3,114, in 1903, 3,251, and in 1904, 3,235. A striking fact brought out by the figures of the report is that during last year the increase of lunacy in rural districts was proportionately larger than in the towns. The Commissioners do not attempt to explain this phenomenon, and the specialists are not more courageous. The worry and stress of town life are not found in the same degree in the country, where existence pursues a more placid course, but intermarriage is more common in small villages than large towns, and conceivably may have something to do with the increase of insanity. Certain counties with a comparatively low rate of insanity show a high proportion of cases admitted with a history of intemperance, and others with a high insanity rate have a low rate of the latter class amongst the insane. For example, the admissions into asylums with history of previous intemperance coming from Glamorgan were 25·3 per cent., whilst the ratio of insane to 1,000 of the population was only 2·47 per thousand. On the other hand, in Dorset the admissions of persons with a record of intemperance was only 3·9; whereas the ratio of insane to 1,000 of population was 3·61. Nor is there any apparent relationship between the density of population and the ratio of insane. Many of the most sparsely populated counties give the highest proportion of insane to their respective populations. For example, the insane ratio was highest in Hertford (5·13), Radnor (4·98), Wilts (4·10), Cardigan (4·09), and Montgomery (3·93), counties which are amongst the least densely populated.

Turning to the assigned causes of insanity in the cases of all patients admitted into county and borough asylums, registered hospitals, naval and military hospitals, State asylums, and licensed houses in England and Wales during the five years 1899 to 1903, it will be found that the largest percentage, so far as males are concerned, is attributed to intemperance in drink, 22·7. The next highest percentage is under the head of hereditary influence, 18·8; then "previous attacks" 16·1. Mental anxiety and worry are answerable for 5·5, and adverse circumstances, much the same thing, for 5·6. Females differ considerably. With them the largest percentage, 24·9, was attributed to hereditary influence, then "previous attacks" 22·4, followed by "other bodily diseases or disorders" 13·1, intemperance in drink coming fourth with 9·4.

One of the most important portions of the report deals with the annual movement of the asylum population. The operation of Section 38 of the Lunacy Act, 1890, Sub-section 4 (as amended by Section 7 of the Act of 1891) has made it possible to judge the extent of this movement of the asylum population in general throughout a series of years. Under that section—a most valuable one—the reception order of any patient can only remain in force if continued by a special report by the responsible medical officer, made at stated periods from the date of admission, to the effect that the patient is still of unsound mind, and a proper person to be detained under care and treatment. Thus a patient admitted in 1891, if still retained in the asylum, must have had his reception order continued by this special certificate issued in 1892, 1893, 1895, 1898, and 1903. By means of such renewals it is possible to ascertain what proportion of the whole number admitted in 1891 and 1892 still remained under care during 1903 and 1904. The statistics show that for every 100 patients admitted in any given year not more than 48 will remain after one year, 37 after two years, 28 after four years, 21 after 7, and 15 after 12 years. It is not possible to give the actual numbers of those who were discharged recovered, or of those who died, nor, indeed, of those who had to be re-admitted, but in general terms it may be said that the highest proportion of recoveries is to be found in the first year, and of deaths in the later years. One-fourth of the admissions are for "not first" attacks of insanity.

HOME INDUSTRIES.

Drying Hops.—An interesting exhibit at the Brewers' Exhibition, held last week, was an American machine for drying and curing hops. With us the hops are kiln dried, the green hops being laid upon floors covered with horsehair, under which are enclosed or open stoves or furnaces. The heat from these is distributed as evenly as possible among the hops above by draughts below and round them. Exhaust fans are used by some growers, and greatly facilitate drying by drawing a large volume of air through the hops, and as the temperature may at the same time be kept low, the risk of getting over-dried samples is lessened. Then the adoption of the roller floor when used in conjunction with a raised platform for the men to stand on when turning, prevents any damage from the feet of the workmen, and reduces the loss of resin to a minimum. The principal objection to the English method, not entirely obviated by exhaust fans, is that hops are dried at too high a temperature, and not evenly. The hot air arising from the fire or furnace comes in contact with the hops lying next the hop-cloth and immediately absorbs moisture from the hops. As soon of this air becomes moisture-laden it is much heavier and cooler, and great heat is required to force the air up through the hops. The result is that the hops next the floor become overdried, while the hops on top remain cold and wet. The air-drying method referred to above dries the hops by a free and continuous passage of air through the hops. No heat is used, and the air is at the normal outside temperature. The circulation and draught are created by a large fan run by an electric motor. The drying is acccomplished by continuously renewed contact of fresh air with the hops. The moisture is absorbed and the brewing qualities left intact. The advantages claimed for the process are that (1) the process of drying begins immediately after the hops are picked, and there is no loss or damage from the sweating process. (2) The drying is accomplished easily and without heat, so that no hops can be high dried, neither will they be slack dried. (3) The hops are not handled in the process and no buds are broken. The resins are left in their natural state, namely, soft and soluble, and the aroma is uninjured. (4) The hops will present a uniform, clean appearance, rendering bleaching with sulphur unnecessary. (5) Being perfectly dried the hops will keep better in the bale as there will be no disturbing chemical changes. The process rests on theory that if you wish to dry any article you should expose it to the air not heat it. The washerwoman does not put her clothes on the oven to dry, she hangs them on the line. The air-drying process was invented, protected, and is used exclusively by a Californian Hop Company. Unfortunately it needs a Californian climate for its efficient application and this is not to be found in Kent.

Incandescent Gas and Electricity.—Something was said in this page last week about the growing keenness in the competition of incandescent gas and electricity as illustrated by the substitution of the former for the latter in the lighting of many of the streets in the City. Another indication of what the electric companies have to reckon with is to be found in the fact that the London and Brighton Railway Company's new station at Victoria is to be lighted by incandescent gas. In the old station it was substituted for electricity at a saving to the company, it is said, of £900 per annum. At Broad-street Station again the incandescent light is supplanting electricity, and Morland and Sons, of the City-road, have given up their electric plant, preferring high pressure gas. The gas companies, alarmed at the rapid progress of electricity, have for some little time past been bestirring themselves and offering householders facilities for the use of the incandescent light, and, if results are anything like those claimed for it, it is probable that the incandescent light will very seriously check the growth of electric lighting in residential houses as well as factories. If a saving of £900 a year can be effected in a single railway station by the substitution of incandescent gas for electricity, and a better light obtained, it is obvious that unless the electric companies materially reduce their charges their position will be seriously menaced. They are young and enterprising, with plenty of capital behind them, and may be relied upon not to shirk the fight, but in both house and street lighting they have found a formidable competitor in incandescent gas.

Motor Wagons.—The demand for motor wagons continues to increase, and for long distances they are steadily displacing the horse. They carry bigger loads, and there is a considerable saving in wages and other expenses. It may be interesting to give the particulars of working expenses of a five-ton motor lorry which was in constant use during twelve months ended September 30th last. It was at work 268 days, and travelled 5,562 miles at the total cost of £286 18s. 8d. The district in which it is worked is very hilly, and during all last winter the roads were in a very bad state, which necessitated a larger use of fuel than would otherwise have been used. The £286 18s. 8d. is made up as follows:—

Wages.

	£	s.	d.
Driver at 35s.	91	0	0
One man at 23s.	59	16	0
Repairs	63	14	5
Oil	22	6	11
Coke (57 tons 6 cwt.)	42	11	4
Boiler Insurance	2	10	0
Incidental expenses	5	0	0
	£286	18	8

5,562 miles × 5 tons = 27,810 ton miles for £286 18s. 8d., which works out at 2·47d. per ton mile, a substantial saving on horse haulage. Unfortunately soft roads prevent the general use of motor wagons for field work.

The Output of Coal.—The figures giving the output of coal for last year afford an amusing commentary on the report of the Coal Commission of 1866, which, by the way, was a very strong one. In their report, issued in 1871, the Commissioners stated that "as regards the future exportation of coal, although a very large increase has taken place within the period embraced by the preceding table (1855-69), yet there is reason to doubt whether much further increase will take place in this direction." The export given in the table for 1869 was 10,200,000. Add 2,100,000 for bunkers, and the total is 12,300,000. From the tables given in the Mines and Quarries General Report just issued, the total export of coal in 1904, exclusive of coke and patent fuel, was 65,822,035 tons, or considerably more than fivefold that which the Commission predicted would not show much further increase. On the other hand Jevons' prediction that the annual percentage of increase in the consumption of coal could not continue unabated for a very lengthy period is already being verified. Just forty years have passed since Jevons wrote, yet the increased production, which for some time previous had been at an average annual rate of 3½ per cent., has, notwithstanding the phenomenal development in the growth of our export, become reduced over the last twenty years to a geometric annual average rate of increase of about 2·16 per cent., and last year was less than 1 per cent., while the rate of increase in the *per capita* home consumption fell from 2½ per centum per annum in the fifties to less than three-quarters of 1 per cent. in the decade ended 1902. The consumption per head of population, 3·89, was lower in 1904 than in any year since 1899, and although the total output of coal was the highest hitherto recorded, viz., 232,428,272 tons, the value was only £83,851,784, as against £88,227,547 in 1903, when the output was less by more than 2,000,000 tons.

Other Minerals Raised.—The total value of the minerals raised in the United Kingdom in 1904 amounted to £97,477,639, a decrease of £4,330,765 as compared with 1903, and accounted for by a further fall in the average price of coal from 7s. 7·93d. per ton in 1903 to 7s. 2·58d. in 1904. The output of iron ore, 13,774,282 tons, shows a further increase of 8,637 tons, but the value, £3,125,814 is less by £104,123 then in 1903. The ore yielded 4,524,412 tons of iron or more than one-half of the total quantity of pig-iron made in the country. 6,100,756 tons of ore were imported during the year, 76 per cent. of which came from Spain.

Gold Mining in Great Britain.—The output of gold from Great Britain (confined to Merionethshire) does not increase very rapidly, but it seems to have made a considerable jump in 1904. In the Mines and Quarries General Report just issued (Cd. 2745) there are tables running back to 1873, of the quantity of ore extracted and its value. Up to 1900 the tonnage dealt with was quite insignificant, but in that year it rose to 20,802; in 1903 it was 28,600, and in 1904, 23,203. But whereas the 28,600 tons were valued (value meaning value of gold obtained less cost of treatment by crushing, amalgamation, &c.) at only £16,995, the 23,023 tons was valued at £68,576. No indication is given in the report of the explanation of this great difference in value. The whole of the output was obtained by two companies, the Gwyn Mines, Limited, working at Gwynfynydd, Merionethshire, and the St. David's Gold Mines, Limited, working at St. David's, Dolgelly. Altogether 19,655 oz. of gold were obtained by these two companies last year of a value, as stated above, of £73,925. The total cost of treatment is estimated to be about £5,349, but £68,576 does not indicate the shareholders' profit, because in order to make an estimate of the profit it would be necessary to deduct all the cost of getting the ore, *i.e.*, labour, supplies, superintendence, royalties, &c. It is to be feared that the nett profit of gold mining in Wales is still to seek.

State Afforestation.—Mr. Fel's proposal to grow forests in Great Britain has given rise to a good deal of interesting discussion. In other European countries the State has done much afforestation to the general advantage, as, for example, in the west of Jutland, where the land is singularly barren, and there can be no doubt that large areas in the United Kingdom might be profitably planted. But if it is to be done on the necessary scale it must be done by the Government. If the State were to take the work in hand it would be the means of finding employment for a large number of hands in one way or another, and the contraction of foreign sources of supply may soon induce statesmen to give more attention to the question of afforestation than they have been disposed to do hitherto, and persuade them to seriously grapple with the difficulties in the way. Meantime we are paying immense sums for foreign timber although less this year then for some years past. Indeed the decrease in the value of wood and timber imports for the nine months ended September last is somewhat remarkable.

Timber and Wood.—Taking wood hewn, the value of the imports for the nine months, which was £4,797,242 in 1903, and £4,395,246 in 1904, was only £4,162,341 in 1905, the decrease being mainly in Russian and American imports. The value of the sawn and split, plain and dressed woods has fallen from £13,278,683 in 1903, and £11,825,079 in 1904 to £11,218,169 this year, the decrease being mainly in Swedish, Norwegian, American, and Canadian imports, the last-named having fallen from £3,107,223 in 1903 to £2,401,219 this year. The total value of the wood and timber imported in the nine months to September 30th of 1903 was £19,919,175, in the same period of 1904, £18,256,364, and this year, £17,268,966; a decrease of no less than £2,650,209 for the nine months of 1905, as compared with the corresponding period of 1903.

GENERAL NOTES.

WHEAT IMPORTS.—Last year our largest imports of wheat came from the following countries in the order given:—(1) British India, (2) Russia, (3) Argentina, (4) the United States of America. For the nine months ended 30th September, 1905, the order has changed, and runs (1) Argentina, (2) British India, (3) Russia, (4) Australia. The United States, which in 1901 gave us 15·60 millions of quarters out of a total import of 23·46, comes fifth, sending us this year, in the nine months to September 30, only 3,606,300 cwt., as compared with 9,394,400 sent by Australia. And this is the more remarkable seeing that the wheat yield in the United States exceeds last year's by 23·7 per cwt., and is only 8·7 per cent. below the record year 1901. Canada, too, has a bumper crop of wheat, but the Canadian exports of wheat to the United Kingdom for the nine months ended September was only 3,020,630 cwt., as compared with 5,514,700 cwt. for the corresponding period of last year. It looks as if the home demand in Canada, as in the United States, is growing more rapidly than the increase in production. Take the wheat exports of the two countries for the first nine months of the three years, 1903-5:—

	United States. cwts.	Canada. cwts.
1903	18,999,026	8,134,441
1904	6,059 900	5,514,700
1905	3,606,300	3,020,630

On the other hand Russia sent us 10,302,702 cwt. in 1903 and 18,701,200 in 1905; the Argentine Republic, 12,989,155 cwt. in 1903, 20,574,800 in 1905; British India, 10,924,942 cwt. in 1903, 20,366,900 in 1905; Australia, 26 cwt. in 1903, and 9,394,400 in 1905.

FRENCH AND BRITISH COLONIAL TRADE.—Some figures given by Mr. Consul-General Inglis in his report on the foreign trade of France just issued (No. 5510, Annual Series), show that the trade of France with her colonies is much more valuable than is commonly supposed on this side of the channel. Taking imports and exports together, they were of the value, in 1904, of £41,792,000, the exports amounting to £22,300,000, and the imports to £19,492,000. Something more than half (£12,596,000) of the exports, go to and nearly a half (£9,352,000) of the imports come from Algeria, the colonies next in importance, from the trade point of view, being Tunis, French Indo-China, Senegal and West Africa, and St. Pierre and Miquelon. The figures quoted seem small beside those of Britain's trade with her colonies and India, but they are far ahead of those of any other country with her Colonial possessions. In 1903 our total imports from India and the colonies were valued at £137,178,061, and our exports at £128,571,535, in all £265,749,396. It is noteworthy that the imports of France from Great Britain in 1904 show a decline of £1,336,000, but remained larger than from any other country, whilst the increase in the exports from France to the United Kingdom amounted to £876,000. The effect of the recent war upon French trade with Russia was great. The imports from Russia fell from £12,068,000 in 1903, to £8,536,000 last year, and the exports to Russia from £3,376,000 to £1,696,000.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, OCT. 30...Farmers' Club, 5, Whitehall-court, S.W., 4 p.m. Mr. J. Crouch, "Rate-aided Education."

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Robert Ball, "A Cruise with the Commissioners of Irish Lights."

TUESDAY, OCT. 31...The Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Discussion on paper by Prof. Ernest Wilson, "Alternate Current Electrolysis." 2. Mr. W. R. Cooper, "Alternate Current Electrolysis as shown by Oscillograph Record." 3. Prof. A. K. Huntingdon, "Note on the Crystalline Structure of Electro-deposited Copper." 4. Mr. W. Pollard Digby, "Some Observations Respecting the Relation of Stability to Electro-chemical Efficiency in Hypochlorite Production."

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, 11 a.m.

WEDNESDAY, NOV. 1...United Service Institution, Whitehall, S.W., 3 p.m. Lt.-Col. G. M. Heath, "Field Engineering in the Light of Modern Warfare."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Alfred Dobrée, "Japanese Sword Blades."

THURSDAY, NOV. 2..Linnean, Burlington-house, W., 8 p.m. Rev. G. Henslow, "Plant Ecology, interpreted by direct response to the Conditions of Life."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. M. H. Spielmann, "Art and Humour."

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. E. Linder and H. Picton, "Solution and Pseudo Solution," Part IV. "Some of the Arsenious Properties of Arsenious Sulphide and Ferric Hydrate." 2. Mr. P. Blackman, "The Molecular Conductivity of Water." 3. Mr. H. O. Jones, "The Stereoisomerism of Substituted Ammonium Compounds." 4. Mr. J. E. Purvis, "The Influence of very strong Electro-Magnetic Fields on the Spark Spectra of Ruthenium, Rhodium, and Palladium." 5 Mr. E. C. R. Prideaux, "Note on the Fluorides of Solenium and Tellurium." 6. "The Constitution of Glutaconic Acid." 7. Messrs. H. Baron and J. F. Thorpe, "Some Alkyl Derivatives of Glutaconic Acid and of 2:6 Dioxypyridine." 8. Messrs. F. V. Darbishire and J. F. Thorpe, "Note on the Formation of β-methylglutaconic Acid and of αβ-dimethylglutaconic Acid."

FRIDAY, NOV. 3...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Geologists' Association, University College, W.C., 8 p.m. Conversazione.

Junior Institute of Engineers, Westminster Palace Hotel, S.W., 8 p.m. Presidential Address. Mr. Dugald Clark, "The Problem of the Gas Turbine."

CORRECTION.—P. 1139, "British Railways," *for* £1,268,500, *read* £1,268,500,000.

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FRIDAY, NOVEMBER 3, 1905.

NOTICES.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One Hundred-and-Fifty-Second Session will be held on Wednesday Evening, the 14th of November, when an Address will be delivered by SIR OWEN ROBERTS, M.A., D.C.L., F.S.A., Vice-President and Chairman of the Council.

Previous to Christmas there will be Six Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section. The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 15.—Opening Address of the CHAIRMAN OF COUNCIL.

NOVEMBER 22.—"The Cinematograph and its Applications." By F. MARTIN-DUNCAN.

NOVEMBER 29. — "The British Association in South Africa." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

DECEMBER 6.—"The Manufacture of Sugar from British Grown Beet." By SIGMUND STEIN.

DECEMBER 13.—"Industrial Japan." By W. F. MITCHELL. HIS EXCELLENCY THE JAPANESE MINISTER, will preside.

DECEMBER 20.—"The Aerograph Method of Distributing Colour." By CHARLES L. BURDICK.

Papers for meetings after Christmas:—

"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By J. NISBET.

"Industrial Russia." By LUCIEN WOLF.

"The Horseless Carriage, 1885-1905." By CLAUDE JOHNSON.

"The Artistic in Painting and Photography." By J. C. DOLLMAN.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

December 7, January 18, February 15, March 15, April 26, May 24.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

February 6, March 6, April 3, May 1.

APPLIED ART SECTION.

Tuesday Evenings, at 8 o'clock:—

DECEMBER 12.—"Historical Pageants." By LOUIS N. PARKER.

December 12, January 30, February 20, March 20, April 24, May 15.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

J. A. FLEMING, D.SC., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

November 27, December 4, 11, 18.

SIR WILLIAM WHITE, K.C.B., F.R.S., "The Modern Warship." Five Lectures.

January 29, February 5, 12, 19, 26.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

HOWARD LECTURES.

A Course of Three Lectures will be given under the Howard Trust, by PROFESSOR SILVANUS THOMPSON, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the followng Thursday Evenings, at 8 o'clock:—January 18th and 25th, and February 1st.

JUVENILE LECTURES.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by PROFESSOR HERBERT JACKSON, on "Flame and Combustion."

CANTOR LECTURES.

Mr. Alan Cole's Cantor Lectures on "Some Aspects of Ancient and Modern Embroidery," and Mr. Herbert Laws Webb's Cantor Lectures on "Telephony," have been reprinted from the *Journal*, and the pamphlets (price one shilling each) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately and are still on sale can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

RESERVOIR, FOUNTAIN, AND STYLOGRAPHIC PENS.

By JAMES P. MAGINNIS, A.M.Inst.C.E., M.Inst.Mech.E.

Lecture III.—Delivered February 6, 1905.

FOUNTAIN PENS.

I cannot do better than begin my lecture this evening by quoting the words of Mr. De la Rue, who says:—"As probably everybody knows, a fountain pen is a pen the holder of which contains a supply of ink which is made to flow to the nib by a device called the 'feed.'" It is the feed which is in great part responsible for the proper writing of the pen. When a filled pen is held point downwards, the ink it contains is acted on by a variety of forces, among which may be reckoned gravity, inertia, capillary attraction, air pressure, friction, and the viscosity of the liquid, as well as several minor forces. If the pen is properly made, these forces are in a state of equilibrium, and the ink does not run out of the reservoir. As soon, however, as the point touches a surface it is capable of wetting, the action of the capillary attraction is altered, with the result that the ink is enabled to flow from the reservoir, and that the pen writes. A fountain pen, to be perfect, should fulfil certain requirements. It should be of convenient form and size, and as light as possible. Its ink-carrying capacity should be as large as is consistent with its portability. It should not be too ready to empty itself, except when required to do so, and then only at a rate not exceeding the requirements of the writer. It should be prompt in delivering the ink the instant the nib touches the paper. It should have as few parts as possible, and these free from complication or liability to injury from careless handling. The possessor of such a pen, provided it be fitted with a gold nib suited to his style of writing, need not ask for a better. Many of those I shall refer to to-night are full of complications, and of what are now proved to be unnecessary parts, whilst others appear to be of the very essence of simplicity, perhaps too much so. Of fountain pens perhaps one may say, as of other things, the fittest survives, and in those of to-day will be found the adoption of the result of the experience of former days. *Experientia docet*. It is another case in which the principle of "trial and error" helps materially to assist one in arriving at the best means to an end.

Frederick Bartholomew Fölsch obtained a patent in 1809 (3235), for "Several Improvements calculated to promote Facility in Writing," wherein he describes his invention shown in Fig. 1, as being divided into three parts, namely, the box, B, the tube, T, and the socket, S, all of which may be joined together by screws, or socket joints. The socket, the lower part of which is made in the shape of a common pen with a slit up the nib, is hollow, and has a hole in the front to admit air, and to adjust the quantity of ink it will bear. At the lower end of the tube, T, is a small pipe, P, for the ink to pass through to the socket. The box, B, contains a small rod, R, one end of which passes through a hole in its bottom,

with a valve, V, covered with leather fastened to it, while the other end screws into a knob, K. A spiral spring, S, keeps the valve or plate close to the cotton of the box. Or, as shown in Fig. 2, the spring may be done away with by screwing the knob at once on to the tube, and making an airhole within the screw part of it, which will admit air into the tube by unscrewing the knob a little.

Again referring to the specification of Joseph Bramah, of September, 1809 (3260), we find that he there claims a patent for "A New Method of Making Pens, Pen-making Machines, Penholders, and Fountain Pens." In this specification, he describes how the handle of the penholder may be a hollow tube of silver or of any other metal or material proper for the purpose, tapering at the lower end to fit the socket, and with a small perforation a little distance from the point, the upper end being made airtight with a cork, cap, or otherwise. The tube is made so thin as to be readily compressed out of circular shape by a small pressure between the fingers and thumb which hold the pen. If a larger supply of ink be required than such a tube will hold at one time, a bulb may be added at the upper extremity or in any other part. Instead of a stopper, a piston may be slided down the interior of the tube to force down the ink to the pen, by the hand or screw, &c. Any common pen, Bramah says, may be converted into a fountain pen, by scraping that part of the quill where the thumb rests, until it is so thin that the pressure of the end of the thumb will be a little more than the necessary force for holding the pen, and by inserting into the open end of the pen above the mouth a small cork, or any substance calculated to operate as a stopper, having previously made in the part of this stopper which falls in contact with the back of the pen, above the slit, a small groove not larger in dimensions than the smallest pinhole, longitudinally along the surface thereof. Here we have a description of a very up-to-date fountain pen, with its feed bar very much as at present used.

In July, 1819, appeared the next patent (4389); granted to John Scheffer for a machine or instrument for writing, which he calls the "Penographic, or Writing Instrument." In this invention the ink is caused to flow to the nib by pressure exerted upon a lever. Generally speaking, the instrument consists of an external metal case, having at the top a stopper of cork, and near the bottom end a cock tube. Inside the case is an elastic tube formed of part of a goose quill, covered with sheep's gut. A valve or plug passing through the cock tube is acted upon by a lever. The nib is described as being formed of part of the barrel of a quill or other suitable material.

FIG. 1.

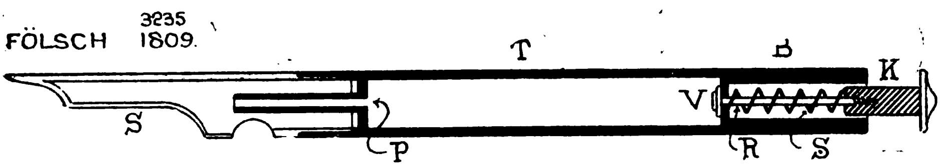
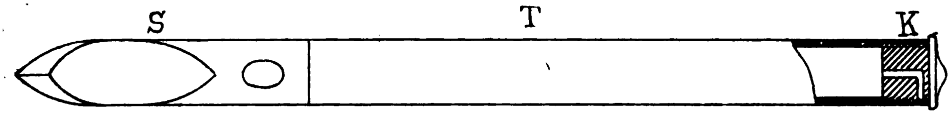


FIG. 2.



In December, 1819, James Henry Lewis, patented "an improvement on pens" (4426) which he calls, "Caligraphic Fountain Pens." This pen was made partly of a barrel of a quill and partly of metal tubes. Ink was caused to flow to the nib by pressure of the finger and thumb, and its flow was held in check by the insertion of a piece of sponge within the lower end of the barrel. The inventor also proposed making the barrel in duplicate, so as to hold different coloured inks, means being provided to supply the nib with either ink at will.

In July, 1827, George Poulton described "an instrument, machine, or apparatus for writing" (5517), which he calls a "Self-supplying Pen," composed of a "tube or reservoir, pen and shield," that may be

attached or separated at pleasure. The reservoir into which the ink is introduced, is screwed on to the pen. There is a weight within it which presses the ink into the pen by its own gravity when in use. The pen is made of steel, cased with metal, to prevent any corrosion, and is partly like a tube, with a valve within it to regulate the flow of ink.

John Joseph Parker obtained a patent (6288) in 1832, "for certain improvements in fountain pens," and he describes his pen (shown in Fig. 3) as having a piston, P, and rod in the barrel, B, with which to force ink to the nib as required, to which it is delivered through a small bell-mouthed tube, T. To fill the barrel, he says, dip the end of the penholder into ink, and raise the piston by turning the outer case. wound and fixed in the barrel of the nib, serving as an ink retainer. This is shown alongside, drawn to a larger scale.

Henry Columbus Hurry patented an improvement (107, 1852) whereby the ink was prevented from leaking out of the penholder when out of use, by the employment of a valve which was capable of closing the ink passage, and rendering the reservoir perfectly air-tight.

In 1852, W. R. Bertolacci describes (537) an "improved pneumatic ink and penholder." It consists, he states, of a tube or reservoir in which is inserted a tube of vulcanised india-rubber, if anything larger than the reservoir. The nib is inserted between these two tubes. The ink is made to flow underneath the nib. A pressure knob passing

FIG. 3.

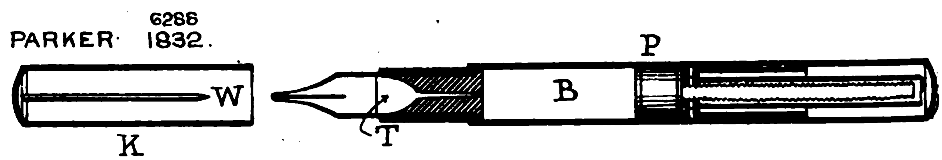
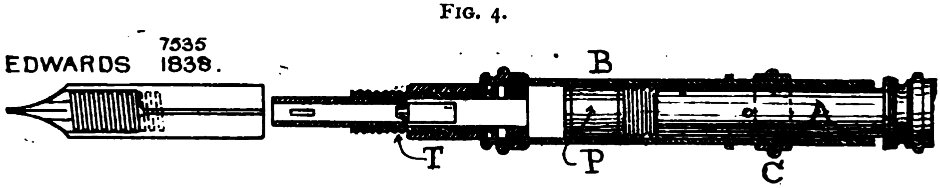


FIG. 4.



In this specification we have the first mention of a so-called, self-filling pen. A wire, W, attached to the inside of the cap, K, enters the ink-delivering passage, and prevents the outflow of ink when the cap is placed over the nib.

A telescopic penholder is shown in Fig. 4 (7535, John Edwards, 1838), formed of two tubes, A and B, each having an air-hole, the upper tube, A, sliding in the lower or ink reservoir, B, one end of the upper tube being packed to form an air-tight piston, P. An air-hole in the ink reservoir is covered by a sliding collar, C, on the outside, packed with leather, cork, or other suitable material to render it air-tight. The upper tube, A, when withdrawn, may be held in that position by turning it round two or three times, when it becomes screwed into the lower tube. A tapering plug, T, is provided in the ink duct, capable of adjustment to regulate the flow of ink to the nib. A wire is spirally

through the reservoir presses against the india-rubber tube. In the upper part of the tube or reservoir is a piston, which is moved up and down by a tube turning round with a screw, moving in the screw of the piston rod. To fill the reservoir with ink place the nib end in a vessel containing ink, and raise the piston by the screw. Methods of delivering ink to the nib are described, by means of elastic bulbs, on which pressure may be exerted as required. A cap is also referred to, which when screwed on the point of the pen renders it safe to carry in the pocket.

In 1855 a patent (410) was obtained by Newell A. Prince for an improvement in the ink feed. This inventor makes his fountain pen, as shown in Fig. 5, principally of hard vulcanised rubber. In the lower end of the reservoir, A, a feed tube is fitted, bored through its middle with a hole which is largest at its upper end. Near the bottom of the feeder an aperture is made, perpen-

dicular to the bore thereof, from which the ink issues to feed the nib. Within is a flat spring, S, whose upper end is wide enough to be wedged fast into the feeder, the rest being narrower than the diameter of the bore, so that it may vibrate freely by the action of the nib in writing. The lower end of the spring is bent nearly at right angles, to allow it to project through the aperture and come into contact with the under part of the nib. As the nib in writing is lifted from the orifice in the feeding tube, the end of the spring follows it, so that the constant motion of the nib when in use aids in supplying it with ink. The piston, P, and rod, R, furnish a ready means of filling the reservoir with ink.

A flat wire, provided with two thumb-plates, extends practically the entire length of the elastic tube, and openings are provided in the tubular part or casing of the pen through which the thumb-plates may be operated. Pressure on the thumb-plates will flatten the elastic ink reservoir, and if the point of the tube be dipped into ink, the expansion of the tube will be followed by a supply of ink. Or ink may be forced on to the nib by a slight pressure on the lower plate whilst writing.

Under the heading, "Fountain Pens," provisional protection was granted to John Butcher (1964), in July, 1870. The stem, he says, is an elastic tube closed at its upper end, and open at the lower end next the nib. To

FIG. 5.

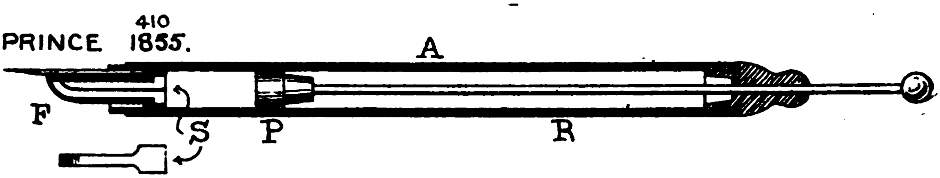
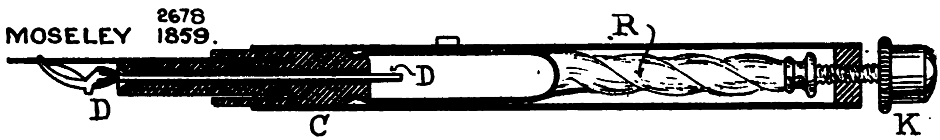


FIG. 6.



Walter Moseley's specification of 1859 (2678), describes a fountain pen (Fig. 6) in which the ink reservoir, R, is constructed of soft india-rubber, to fill which with ink, a screw cap, K, is turned a few times, whereby the india-rubber becomes twisted and forces the air out. On turning the screw the reverse way, and at the same time dipping the end of the penholder in ink, the india-rubber resumes its tubular form and draws up a supply of ink. To regulate the flow of ink to the nib, the part, D, may be adjusted in the plug, C. Pressure on the flexible tube (where it is exposed through an opening in the metal casing) will force ink downwards to the nib. The inventor sometimes provides a small knob or button for this purpose, as shown in the drawing, instead of leaving the india-rubber tube exposed.

In the invention of John Darling, in 1867 (288), the tubular part of the pen is, as the inventor states, completely filled (*i.e.*, from end to end) with an elastic tube, from which a distributing tube terminates under the nib.

charge the tube the air is expelled by twisting, drawing, or squeezing it; this being done, its resilience draws in the ink. The elasticity of the tube allows ink to flow to the nib for some time, and the supply is kept up by twisting or squeezing the tube. In combination with the tube are either two removable nibs, both of which, or only the under or writing one, are slit; or a piece of fibrous or porous material, to prevent too rapid a flow of ink to the nib.

Messrs. Rheinberg obtained provisional protection in November, 1870, (3002) for "Improvements in Penholders." No drawings are published with the specification, but we are told that the handle is tubular, and forms, with a flexible tube at its lower end, an ink reservoir. At one side of the handle there is a stud, on which "the finger presses in writing." This stud abuts on the flexible part, presses it inwards, and causes ink to flow out through a small hole in the bottom thereof into the pen. To charge the reservoir, the hole is immersed

in ink, and a piston which is contained in the hollow handle is drawn up.

In Stewart's patent of September, 1878 (3644), Fig. 7, an elastic tube, A, is protected by a barrel, B, of metal, or hard vulcanite, rendered somewhat flexible by suitable perforations. The head, E, or, as it usually called, the point section, is fixed in the barrel, and a slit, F, is provided in it for the reception of the nib, and a central duct, G, closed at its extreme end, through which ink is supplied to the under side of the nib. The pen may be filled by suction through the air opening at N. To prevent ink escaping when the pen is carried in the pocket, a cap or sleeve is provided, which may be turned one-half a revolution so as to cover the orifice supplying ink to the nib.

In November, 1878 (4714) S. Fox obtained provisional protection for a fountain pen. The penholder is tubular, and has attached to its upper end a length of flexible tubing of small diameter, the other end of which is connected to an ink bottle. To assist the flow of ink, the ink bottle is raised somewhat above the level of the writing table, preferably upon a stand the height of which might be adjusted to the most suitable elevation. The penholder terminates in a very small tube, fixed immediately under and against the nib, and being provided with a regulator whereby the flow of ink may be regulated. When not in actual use the pen is inserted in the ink bottle. This inventor further suggests that the ink bottle may be made to hook into the buttonhole, or be otherwise attached to the person.

The drawing, Fig. 8, shows a section of a penholder patented in June, 1879 (2261), by R. Spear. It consists of a holder and ink reservoir, A, to which the feeder of ink, B, to the nib, C, is joined. When the nib, C, is in position, the feeder, B, extends nearly to its point and almost touches its under side. A piston, F, with its rod, G, fits inside the reservoir, A, and is operated by the pin, H, slightly projecting through the holder, A, in which a slot is provided for its accommodation. The piston rod, F, is guided by a diaphragm, D, through which it passes. This diaphragm divides the ink reservoir from the upper half of the holder. To fill the reservoir the point of the holder is immersed in ink, and the piston drawn slowly upwards, when the ink is drawn into the holder.

F. W. Monck, in December, 1879 (4943), patented the method of regulating the supply of ink from the reservoir to the nib, shown in Fig. 9. The main reservoir is divided from the point by a wall or diaphragm, in which is a small opening, as shown at L. The pen-carrier, D, is pivoted at E, to a rod, M, carrying a valve, C, fitting the opening, L. The rocking action

Fig. 7.

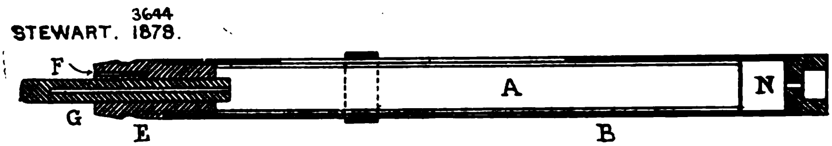


Fig. 8.

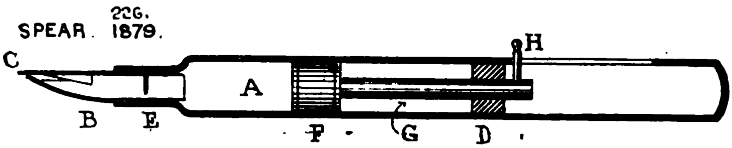
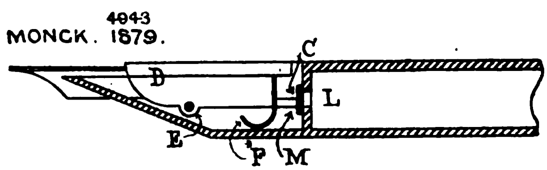


Fig. 9.



of the pen in writing opens the valve and allows ink to flow to the nib, whilst the spring, F, tends to keep the valve closed.

In July, 1880 (2879), Mr. A. T. Cross patented a pen, as he describes it, with a reservoir to which air is admitted at the lower end, and to be used with ordinary nibs. A section of the pen is here shown in Fig. 10, and compared with the fountain pen of to-day it is a complicated instrument, full of details which experience has proved to be superfluous. It has some

Another instance of a self-filling pen is referred to in the provisional patent of A. Tust, November, 1880 (4624), in which the ink reservoir is of the usual tubular form fitted with a piston and piston rod, which former also acts as a pressure valve to force the ink to the pen. The holder in which the nib is fixed is so arranged that it forms a valve to prevent too ready a flow of ink. Pressure upon the nib, as in writing, opens this valve.

Fig. 10.

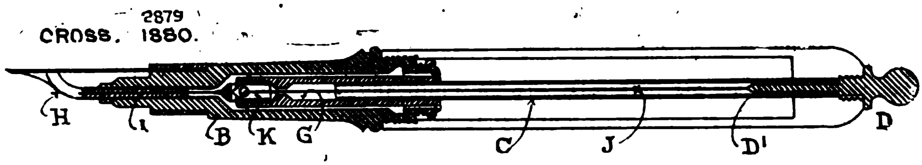


Fig. 11.

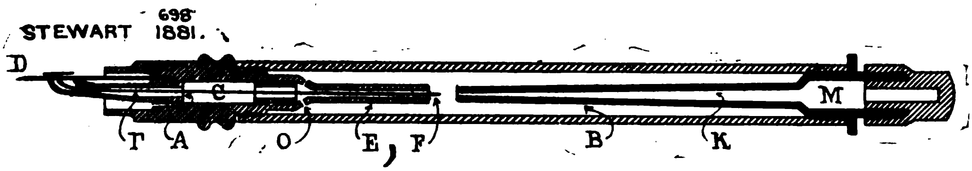


Fig. 12.

resemblance to the stylographic pen, and the inventor claims protection in the same specification for a stylographic pen having a somewhat similar interior arrangement of parts. In a fountain pen, the air tube, C, has at its lower end an adjustable sliding guide, G, to which a tube-clearing spindle, I, is rigidly fixed. The spindle, I, passes through a small ink-delivering tube, H, which is frictionally held in the bore of the point section, B. A fine connecting wire, J, attached to the guide, D', which extends from the vent plug, D, into an air tube, and passes through a contracted part of the guide, G, to which it is loosely secured, by its enlarged head being held in the chamber, K.

Stewart's patent of February, 1881 (698), consists of the usual ink reservoir, B (Fig. 11) within which is the air tube, K, enlarged at its upper end, M, and extending about two-thirds of the length of the ink reservoir. The point section is extended upwards, as at E, and openings, O, are provided, through which the ink finds its way downwards into the ink chamber, C, and thence by means of a short tube, A, to the nib, D. A capillary wire, F, is fitted to the top of E, and passes downwards to the nib, D, at the back of which it is formed into a coil, shown at G, to prevent the nib from becoming too dry when not in use. This wire forms a conductor for the air, entering in the form of minute bubbles, which gradually pass

upwards along its surface into the ink chamber, C, where they collect and form an elastic cushion between the ink contained in C, and that in the reservoir, B. This pen (also shown in Fig. 12) was introduced by Messrs. Mabie, Todd and Bard, of New York, as the "Calligraphic" Fountain Pen, and Mr. Robinson was the first to bring it to England.

Jackson's prov. patent 1881 (907), provides a flexible tubular reservoir of india-rubber, enclosed in an outer holder or casing. One end is attached to the lower end of the holder in which a passage is formed to carry the ink to the nib. The other or upper end terminates in a plug, turning which twists the flexible reservoir, and drives the contents, whether this be ink or air, outwards. To fill the reservoir the tube is untwisted whilst the point is inserted in ink.

is supported by a sleeve, and a small plunger or piston is placed against it so that pressure with the finger on this plunger compresses the rubber tube, and thus forces ink through a small opening immediately under the nib. The lower part of the reservoir is fitted with a plug terminating in a tubular feeder, with a small opening, through which passes a rod, said to be of some non-hygroscopic material to assist the flow of ink.

The ink reservoir of Sparling's pen of 1881 (3887), is closed at its lower end by a plug, perforated by a single hole, through which the ink passes to the nib. Into the other end a rod slides, packed so as to form an airtight piston by means of which ink may be drawn into the reservoir, or forced down to the nib.

In W. W. Stewart's patent pen of Feb-

Fig. 13.

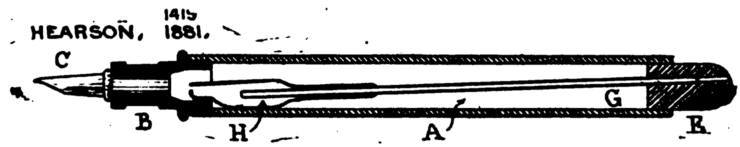
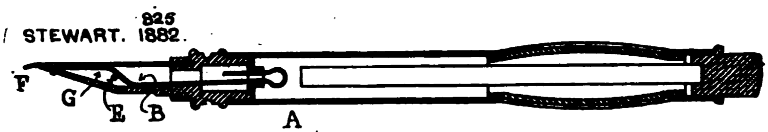


Fig. 14.



In T. R. Hearson's patent of March, 1881 (1419), Fig. 13, the reservoir, A, is fitted at its upper end with a plug, E, into which the air tube, G, is fixed. At the other end is fitted the nib holding piece, B, which is removable for filling the reservoir. The air tube, G, is inclined as shown, and is surrounded by an ink chamber, H, which serves to form a trap to prevent ink running into the air tube. The nib, C, is of the barrel type, and is surrounded by a thin india-rubber covering through which the points of the nib project slightly. The rear end of the nib is open to the ink reservoir, and the nib is kept fully charged with ink. As soon as pressure is brought to bear on the nib in writing, the points separate, and an ink passage is established which keeps the nib supplied. This immediately closes when pressure is relaxed.

In Poznanski's pen of 1881 (2754) at the top of the ink reservoir is fitted a soft rubber tube, one end of which is closed. This tube

ruary, 1882 (825), a section of which is shown in Fig. 14, in which a permeable strand, B, of cord or straw, or other suitable substance, is arranged to conduct the ink from the reservoir, A, to the nib, F. It is held in close contact with the nib by a pin, E. An ink tube or gutter, G, is formed under the nib. The interior of the reservoir is described as being glazed in order to attract globules of air, or glazed parts are introduced to effect the same purpose.

Cohn's pen of 1882 (840) was only provisionally protected, but shows the desire to produce a self-filling pen. The reservoir consists of an elastic tube closed at the top and communicating at the bottom with a small pipe, through which ink passes to the nib. To drive ink to the nib, and also to allow the tube to be filled by suction, the tube is compressed by means of a longitudinal block fitted in a slot in the penholder, and bearing against the flexible ink reservoir. In another form, a pin projecting through the

end of the penholder might be twisted, and with it the flexible tube.

Messrs. Hughes and Carwardine, in August, 1882 (4152), patented the method here illustrated in Fig. 15, of conducting ink to the nib by means of an india-rubber bag, B, through which the point, A, of the nib passes, as shown. Pressure upon the nib in writing causes the points to spread apart, thus expanding the opening in the rubber bag and allowing ink to exude. The rear end of the rubber bag is carried through the cylindrical part of the barrel of the pen, and turned thereover, as may be seen. In order to prevent ink from escaping at the point of the nib, the nib and bag are dipped in india-rubber solution.

FIG. 15.

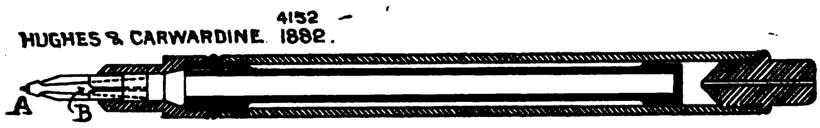


FIG. 16.

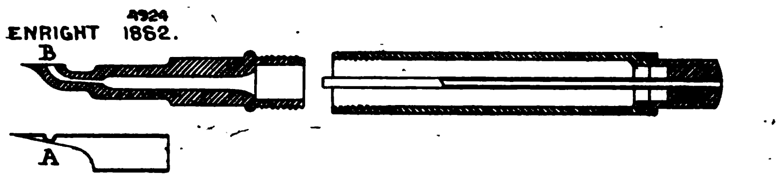
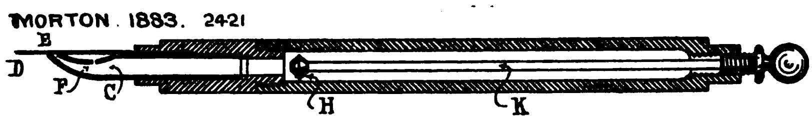


FIG. 17.



In Fig. 16 is shown the point section of a pen patented in October, 1882 (4924), by R. Enright. It will be seen that the ink passage takes an upward bend, and terminates immediately under the nib. The nib, illustrated separately underneath, is of barrel form, and has a distinct depression, A, which, when the nib is placed in position, completely closes the opening, B, of the ink passage in the manner of a valve. This valve would naturally open by pressure on the point of the nib in writing.

Robert Shaw, in October, 1883 (2411), used a tubular holder of metal or other material, entirely closed except at the lower end where the nib is entered, and at this opening, or a short distance therefrom, a cross or bridge piece is fitted in as support for the ink. Through the opening which admits the nib a number of very fine wires, hairs, or other minute fibres are passed, soldered, or otherwise fixed on the top of the holder, whilst their opposite ends lie against the under side of the nib, terminating within a short distance of its points. There is a small air-hole in the lower end of the holder. This, I think, is the first mention of air being admitted at the lower end.

In 1863 (2227) Joseph Maggs describes his invention of a fountain pen, in which the holder is hollow and contains a flexible tube of india-rubber, closed at its upper end, and connected with a short spiral tube which forms its mouth, at the other end. The spiral tube extends to near the point of the nib, and a slight pressure on the tube by the thumb or finger, in the act of writing ensures the requisite down-flow of ink. It is presumed (as there are no drawings published with the specification, which was only a provisional one), that there was an opening in the side of the metal holder to permit of the finger pressing upon the flexible reservoir. This is evidently a pen of the self-filling type.

In the patent of J. Morton, of July, 1883 (2421), shown in Fig. 17, a valve, H, is carried on a rod, K, which, at its upper end, is screwed into the end of the ink reservoir. When this rod is closely screwed down the

valve completely closes the ink passage, and thus prevents risk of leakage when the pen is lying flat, or carried in the pocket, point downwards. Ink is conveyed to the nib, D, when required, through the feed tube, C, to the vent, E. A small opening is also provided at F, to admit air.

Referring to Osborn's pen of 1882 (5558) a long pin passes through the ink reservoir, carrying two small valves, which regulate the supply of ink to the nib. These valves are normally held closed by springs. The nib is carried on a tube connected to the ink feeder. Pressure on the nib in writing opens both valves simultaneously, one admitting air, and the other allowing the flow of ink to the nib. ink is forced downwards. By untwisting the reservoir the ink is withdrawn from the nib. Provision is made whereby it is impossible to twist the flexible tube to destruction.

In Mr. J. F. Williams's invention (4505) of September, 1883. The reservoir consists of a tongue or tube, D, Fig. 18, capable of holding a considerable quantity of ink, and of delivering it at the underside of the nib, C, fitted in the usual manner into the tubular holder, A. The tongue, D, is carried on a rod, F. The upper end of this rod is fixed to a cap, E, which slides telescopically upon the holder, A, and which may be pressed forward against the spring, G. To fill the tongue, the cap, E, is compressed, and the tongue on being dipped

FIG. 18.

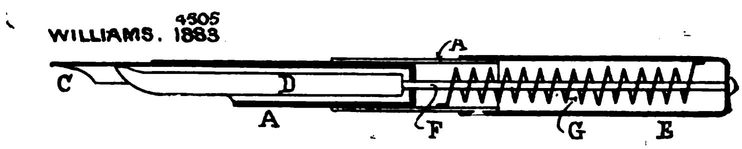
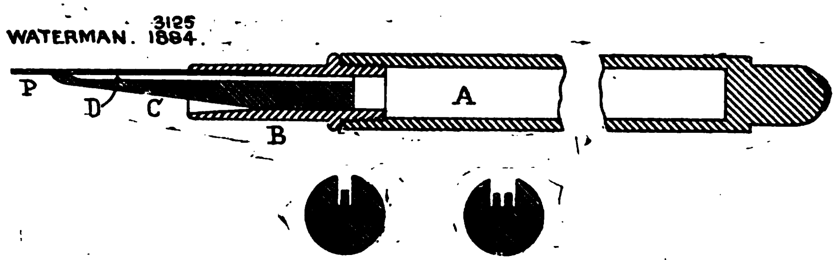


FIG. 19.



In Bertram's pen of 1883 (3268), the air tube (solid at its lower end), is fixed to the cap which screws on the end of the ink reservoir. The solid end of the air tube fits into, and closes the ink passage, through which the ink finds its way to the nib. When the cap is partially unscrewed air is permitted to enter the tube by an opening provided, and thence to the ink reservoir. The solid end is also thus raised from its seat, and ink is permitted to flow to the nib.

In Vale's pen of 1883 (4401) an elastic ink reservoir is contained within a protecting covering. The lower end of the reservoir is fixed to a mount, in which the nib is placed, and through this mount is a passage leading the ink to the under-side of the nib. The other end of the flexible reservoir is attached to a mount, controlled by a screwed cap. By turning the cap the reservoir is twisted, and

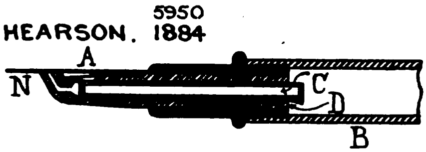
into ink becomes filled, and is then withdrawn to the position shown, by the action of the spring. This cannot be called a portable fountain pen. The inventor evidently intended to save frequent dipping into the ink-pot.

Fig. 19 shows the feed bar of L. E. Waterman, in 1884 (3125). The ink reservoir, A, carries a point section, B, at one end, and the feed piece, C, fits tightly into the point section. An ink duct, D, is formed along the feed, and consists of longitudinal fissures or saw cuts. The nib, P, is secured between the feed and the point section, and ink is fed to the nib by gravity and capillarity, air being drawn into the reservoir along the fissures of the ink duct. Below are transverse sections of the feed bar showing two arrangements of ducts. It will be seen that the main groove contains in one case two minor grooves, and in the other three, very fine saw cut grooves. These commence at the back

end, and extend nearly to the point as shown in the longitudinal section.

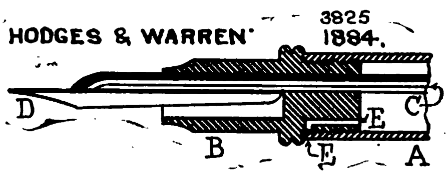
Mr. T. A. Hearson's pen of April, 1884, (5950), is illustrated in Fig. 20. In this drawing is shown a form of feed having two distinct passages, the upper one formed by the tube, C, conducts the air from the aperture, A, into

FIG. 20.



the ink reservoir, B, whilst the other passage, D, is formed by the tube, C, being flattened on its under side permitting the downward flow of ink to the nib, N. An arrangement not shown, is described, whereby ink may be prevented from passing along the channel, D, so that the pen may be safely carried in the pocket.

FIG. 21.



The feed arrangement of Hodges and Warren, of March, 1884 (3825), is shown in Fig. 21. In this pen a long tube, C, slit up its entire length, extends nearly to the top of the ink reservoir, A. The end of this tube is bent over at its lower end, and delivers the ink to the back of the nib, D, at the slit or pierce. An air hole, E, is provided to facilitate the escape of air while screwing the point section, B, into place in the reservoir.

Fig. 22 shows F. B. Michell's patent of September, 1884 (12092). Here the holder, F, contains a flexible rubber bag, C, from which the ink is expelled while writing by the pressure of the fingers, the holder, F, being slotted for this purpose. Ink is fed to the nib by means of the tube, A, and in the drawing it is shown as being delivered on the top of the nib. I possess a similar pen in which the ink feed is underneath the nib.

In Fig. 23, Köllisch's patent of 1884 (16800), the ink reservoir, A, is formed of a rubber tube from which the ink is ejected by twisting. The reservoir, A, is attached to the part, C, which carries a toothed ring, D, in gear with the outer casing, G, and also with the ring, F, attached to the cap, B. On turning the cap, and with it, D and C, the reservoir, A, becomes twisted. The teeth on G, prevent A from returning unless the cap be raised sufficiently to disengage the teeth which are kept in gear by means of the spring, E. As in other similar arrangements the reservoir is filled by allowing it to become untwisted whilst the point is immersed in ink.

In Brown's patent of 1886 (9132), the ink is distributed over the upper surface of the nib, by the feed bar, which is suitably formed for the purpose, and grooved to regulate the flow of ink. The air inlet consists of a tube, bent round at its inner end, so that the opening may face the plug through which the tube passes. A diaphragm is so pivoted as to be capable of entirely cutting off the ink from the nib.

In Bartram's pen of 1885 (10070), the ink is contained in the holder in the usual manner,

FIG. 22.

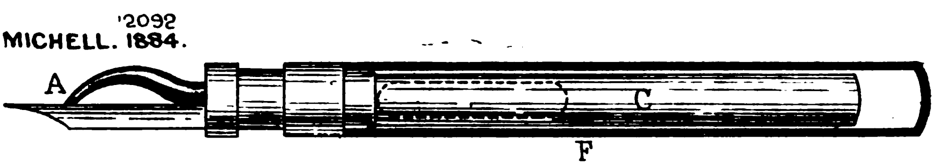
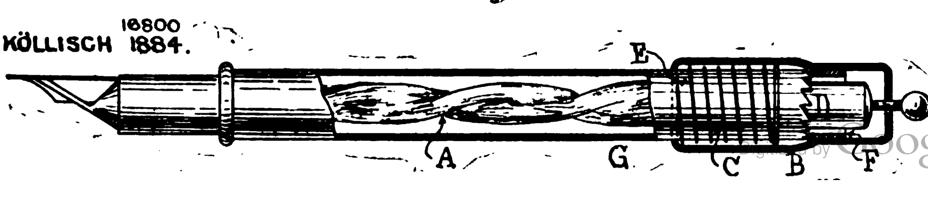


FIG. 23.



and flows to the nib, along a groove in the ink conductor. Entering this groove it is drawn downwards as the nib is moved in writing. An enlargement is formed in the conductor, having notches or serrations to permit of a free passage of air through the openings, in a diaphragm, into which latter, the ink conductor, or feed, is screwed. When it is desired to prevent ink from flowing, the conductor is screwed outwards till the opening is covered, in which condition the pen may be carried in the pocket. A rubber ring holds the ink conductor steady.

tains a reservoir, F, of india-rubber or other elastic material. This is attached at its upper end to a screwed rod, B, and a knob, A, by which it may be twisted to expel ink or air. A stud or pin, D, is placed at the side, and the reservoir, F, may be compressed by this means. Ink is delivered to the nib, N, through the passage, G, to C. The tongue, K, acts as a spring to grip the nib.

In Ridge's pen of 1886 (9346), shown in Fig. 26, the reservoir, B, is made of glass, drawn out at one end to a point through which a wick, C, projects against the nib, D. A

FIG. 24.

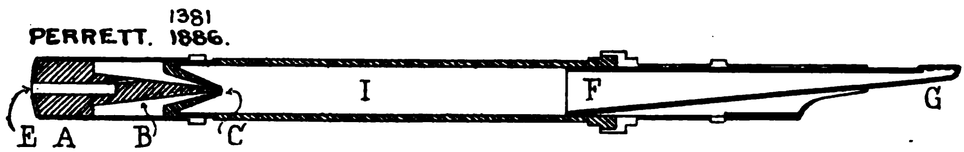


FIG. 25.

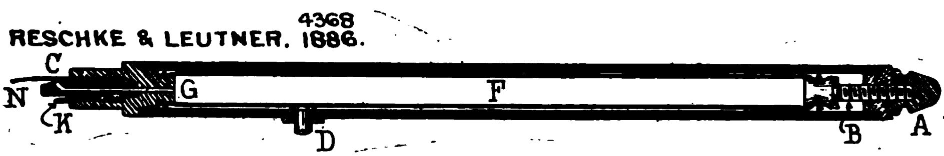


FIG. 26.

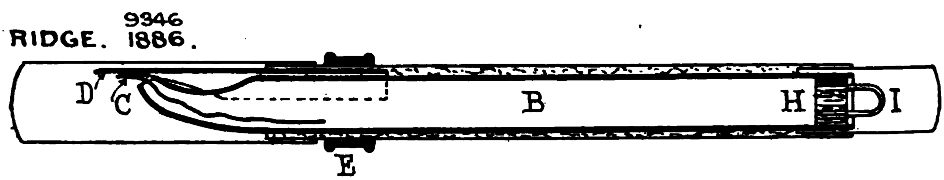


Fig. 24 shows a section of Perrett's pen of 1886 (1381). The tubular reservoir, I, is formed with an air-valve, C, and an ink conducting tube, F. The valve, as may be seen, is formed by a tapering point, B, attached to the cap, A, and by means of the latter, which has a screw connection with the reservoir, I, it may be raised or lowered as desired by turning the cap. Air is admitted at E, and when the valve is open, finds its way into the ink reservoir. The ink conducting tube, F. is of tapering form, and has a groove along which the ink flows to the spoon-shaped extremity, G. This is another instance in which air is admitted at the top of the fountain pen.

Another pen with a flexible rubber ink reservoir was patented by Reschke and Leutner, in 1886 (4368), and is shown in section in Fig. 25. The tubular holder or casing con-

movable plug, H, closes the upper end of the reservoir, and this is provided as shown with a wire loop, I. This plug may be pushed down the reservoir to the lower end, and raised to the position shown by a hooked rod, and thus the pen may be charged with ink. To protect the glass tube it is covered with an outer case, into which it is fitted by suitable packing. A sliding ring, E, is provided as a means of holding the nib in position.

Mr. G. H. Sackett's patent, August, 1886 (10827), shown in Fig. 27, an exaggerated barrel pen, made of metal, closed at its upper end and terminating at its lower end in a writing nib having an extra long slit. The lower end of the tube is closed also, so that any ink contained in it can only escape through the slit, to the point of the nib, and then only during the operation of writing.

In Sackett's patent of 1886 (12323), shown in Fig. 28, the tubular reservoir, A, is closed at one end, and provided at the other with a movable diaphragm, B, having a crescent-shaped slit for receiving the nib, C, and for allowing the proper flow of ink. A tongue, D, is attached so as to rest on the back of the nib, and a long feed bar or stem, grooved along its entire length, is attached to the back of the diaphragm, B. This feed bar is so bent that it may slide stiffly into the reservoir, thus enabling the holder to be refilled, without the necessity of entirely removing it. A minute opening in the diaphragm, B, admits air to the ink reservoir.

In the patent of Brown, of 1886 (15638), the inventor has turned his special attention to the feed arrangements, and the drawings shown in Fig. 29, give some idea of his various forms of feed bars. The inventor has a preference for an elliptical or triangular opening in the point

FIG. 27.

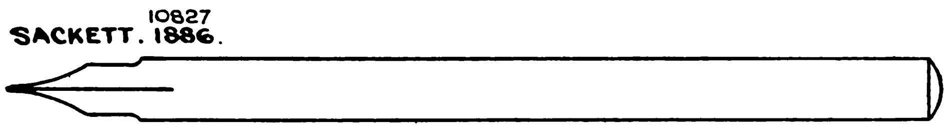


FIG. 28.

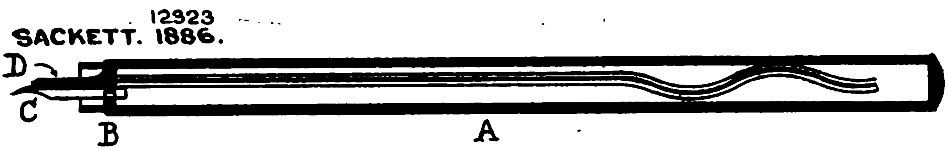


FIG. 29.

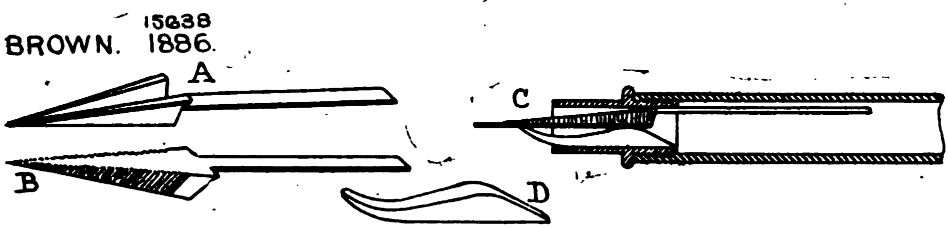
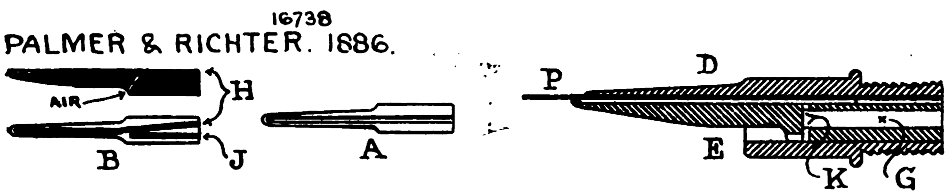


FIG. 30.



section, the feed bar itself being generally triangular in section, and more or less grooved to form air and ink ducts. In A the feed bar is pyramidal with a deep V-shaped groove, and a rearward extension. In B, it is grooved transversely. In either case the feed bar is placed over the nib, having an edge or apex in contact with it, as shown in C, the nib resting on the seating shown in D. The surface of this seating does not fit closely to the nib, in order that a void may exist to hold an additional supply of ink.

Palmer and Richter in their patent of 1886 (16738), claim improvements in feed bars. The reservoir is of ordinary construction. The point section is here shown in Fig. 30, provided with a beak, D, fitting over the nib, P. The feed bar, E, is hollow at G, with a channel extending the whole length of its upper surface which comes in contact with the nib, P. A channel is provided for the passage of the air which

FIG. 31

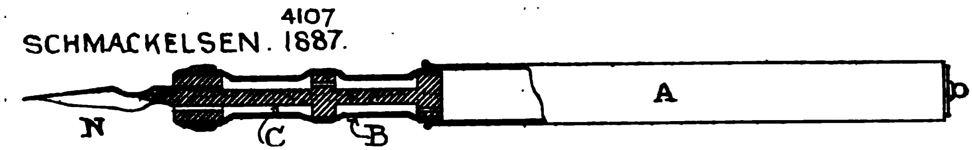
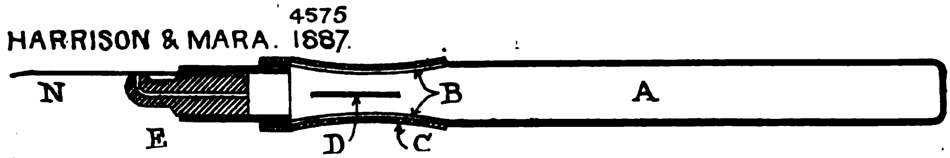


FIG. 32.

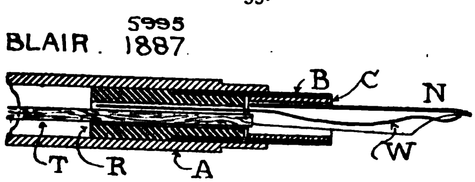


enters through openings at K, into the cavity, G. At A, is shown a plan of the feed bar, with the channel or groove along its upper surface. A modified form of feed bar is shown at B, the upper view being in section. In this, ink travels along the groove, H, to the nib, whilst air enters at the point indicated by the arrow, and passes along the shorter groove, J.

Fig. 31 is the invention of J. Schmackelsen in 1887 (4107). This is a combination of both rigid and flexible ink reservoir. The reservoir, A, is prolonged by the addition of a flexible tube, B, stiffened by a rod, C, provided with bosses supporting the flexible tube at intervals. Ink passages are formed in the bosses as shown. A ring at the end forms a termination to the flexible tube, and supports the front end of the rod, C, thus forming a holder to contain the nib, N. The rod, C, also carries ink to the nib. The flexible tube collapses, more or less, with the pressure of the fingers of the writer, and ink is thus forced forward.

Another flexible ink reservoir is here shown in Fig. 32, Harrison and Mara, 1887 (4575). The tubular holder, A, is of metal, and is provided with openings, B. These openings are covered with india rubber or some other elastic material, C, whilst the sides are stiffened by a partition, D. A section of the feed bar, E, shows the method of delivering ink to the nib, N.

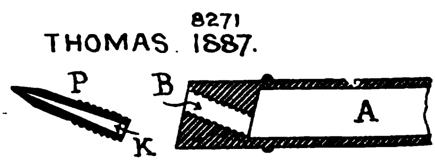
FIG. 33.



In Blair's pen of 1887 (5995), a part section of which is shown in Fig. 33, a corrugated tube, B, has a rubber tube, R, pushed in at the rear end to form a tight joint with the holder, A, and a second corrugated tube, C, inserted at the front end of the tube, B, provides a holder for the nib, N. The ink travels along the metal strip, which is held in position by the absorbent wooden rod, T. This rod, T, serves also to absorb any excess of ink in the passage when the pen is out of use.

In Fig. 34, W. J. Thomas, 1887 (8271), it will be seen that the reservoir, A, is perforated by an opening, B, at an inclination from the axis of the pen. Into this is screwed a short tube, P, through which

FIG. 34.



the ink flows to the nib. This tube has a tapering bore, as shown in the section at K, and a piece of cane is inserted therein. The nib is held in position by a bent plate, neither of which are shown on the drawing. The object in placing the feed tube at the angle shown is to prevent leakage when the pen is placed on a desk, and the holder is so weighted as to automatically keep the pen in the position indicated. Air is admitted at the top of the reservoir.

Again, in Fig. 35, is a flexible reservoir, patented by W. E. Burton, in August, 1887 (11728). A short rubber tube is fixed inside the outer protecting tube, A, and may be operated from the exterior by the stud and plate, B. Pressure on the stud compresses the flexible tube and forces a small quantity of ink to

the lower end of the pen, as shown, whilst air is admitted at V. On reversing the pen, the ink from the pen flows backwards to the chamber E.

The flexible ink reservoir is again shown in Fig. 36, patented by de Lambert in 1887 (15625). The tubes, A, B, form the reservoir. In B is a slot or opening, C, into which a small sponge is inserted, and a flexible rubber sleeve,

In the invention of G. H. Jones (7293), May 1888, the reservoir consists of a glass tube, drawn to a fine point at one end, and covered at the other after the manner of a drum with some elastic material, on pressing which ink is forced ont through the point to the nib. The reservoir is filled by heating the tube and then dipping the point in ink.

FIG. 35.

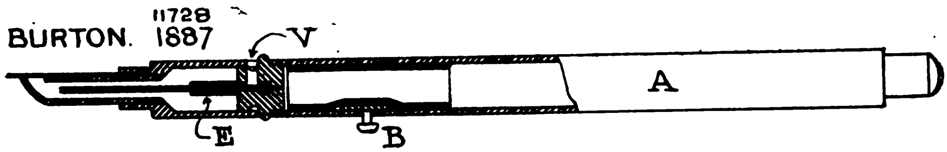
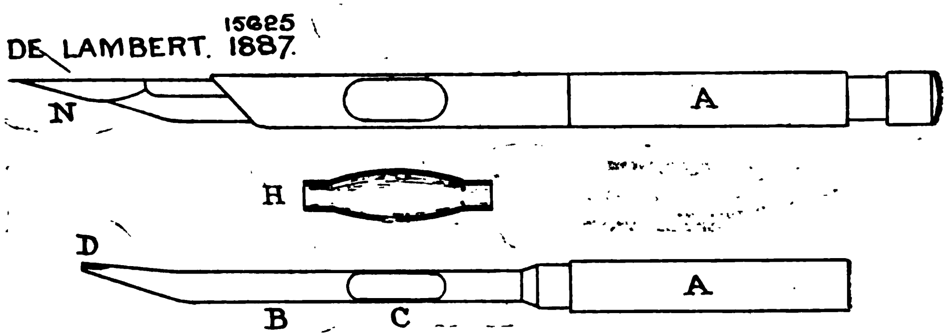


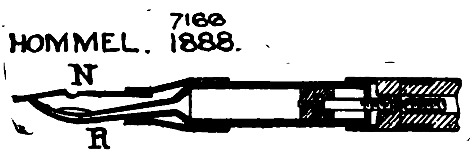
FIG. 36.



H, is slipped over this opening. Another metal tube is placed over this, as shown in the drawing of the complete pen, and this also has a slot or opening through which may be seen the rubber sleeve, H. Pressure with the finger upon the rubber sleeve forces ink through the opening at D to the nib, N.

In Fig. 37 we have Hommel's patent of 1888 (7166), being another instance of the introduction of a mechanical arrangement for draw-

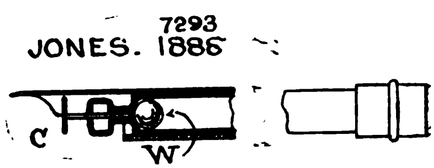
FIG. 37.



ing in or discharging ink by means of a piston, Ink is supplied through the fine tube, R, to the nib, N.

Fig. 38 shows a self-acting device by the same inventor for closing the ink outlet when

FIG. 38.



the pen is reversed. The disc, C, falls down upon the orifice; W is a weight provided to ensure its doing so.

There appears to be nothing particularly striking in this pen (W. Guthrie, 1888, 10934). In using the pen, it is first held with the point upwards, and then inverted, when a drop of of ink flows to the nib. When this is used the pen is again held point upwards, and so on.

In the invention of E. Lacon, in 1889 (8534), the reservoir is of glass or of other transparent

material, and the other protecting cover is slotted, so that the quantity of ink within may be readily seen. Fig. 39 shows the general appearance of the pen. A valve is provided for controlling the admission of air. A ring is placed on the upper end, capable of sliding up and down for the purpose of opening or closing the air inlet valve, V.

In Fry's patent of 1889 (10435), the reservoir is closed by a plug, and the feed bar is perforated by minute holes, so formed that the edges of the opening are in contact with the nib. For the purpose of regulating the flow of ink into the feed tube a plug is provided, into the reservoir for its entire length, as a means of forcing ink to the nib.

Falconnet and others took out a patent in 1889 (7784), for a piston type of pen, the ink being expelled from the reservoir by the movement of the piston. The piston has a threaded perforation, through which passes a rod, the rear end of which is secured to a cap, and as the cap is turned, so the rod is also turned, and by reason of the screw the piston is thus made to traverse the interior of the reservoir. The ink flows to the nib through a tapering tube or feed bar which is slotted under the nib

FIG. 39.

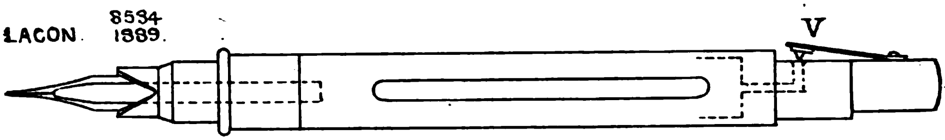


FIG. 40.

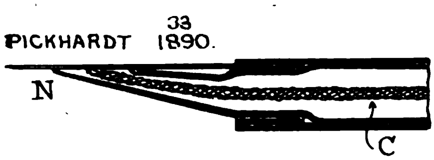


FIG. 41.

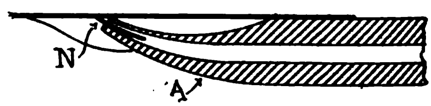
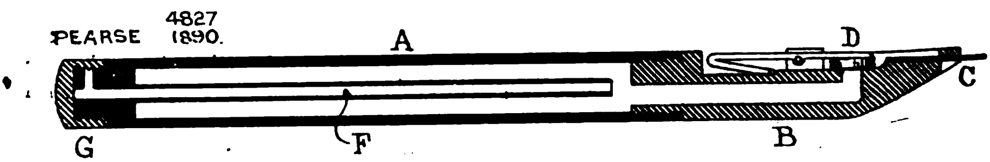


FIG. 42.



which may be screwed down to close completely the passage to the feed tube. When unscrewed the ink flows through the orifice.

Fig. 40 shows Pickhart's pen of 1890 (33), the reservoir of which is made of glass drawn to a fine point. Within the tapering point is placed a tube C, of gauze or woven asbestos, the end of which is in contact with the under side of the nib, N. A modification is shown in Fig. 41, where the point or feed tube, A, is of vulcanite, and, instead of the gauze tube, C, of Fig. 40, a tongue is cut from the nib, N, which is in contact with, or just enters, the ink outlet.

H. Pearse designed a pen in 1890 (59), which instead of having the familiar piston and its rod is fitted with a plunger screwing

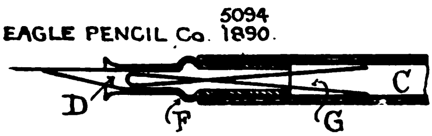
In the invention (3252) of Hill and Appleton, 1890, the reservoir is of gutta percha (placed within a metal tube), and is open at one end, and closed at the other. Into the open end is screwed the feed bar, which is hollow, and has two small openings for the admission of air, and out-flow of ink to the nib placed immediately over them.

In Fig. 42 Pearse's patent of 1890 (4827), the nib, C, is carried on a part, B, screwing into the reservoir, A. The outflow of ink is regulated by a valve, D, operated by a lever as required. Air is admitted at the other end of the pen through a tube, F, which is covered by the cap, G, when out of use.

This pen, Fig. 43, the production of the Eagle Pencil Company, 1890 (5094), is described

as being formed in three parts, the reservoir, the barrel, and the feed tube. The reservoir, C, is connected to the barrel by an elastic tube, F. The feed tube is formed with a swelling or shoulder, which prevents it slip-

FIG. 43.

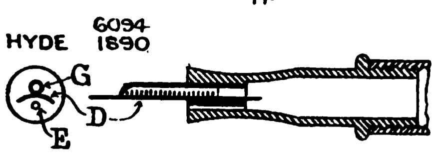


ping too far forward, and it is slotted for the ink to flow to the nib. A folded wire, G, passes from the feed tube to the reservoir.

The Eagle Pencil Company, in 1890 (15053), describe a pen in which the nib is held between the barrel and the ink conductor. At the rear end of the barrel is an india-rubber tube connecting it to the reservoir. The ink conductor or feed bar has one or more longitudinal grooves, and a saw-cut under the point renders it more flexible.

In Hyde's patent of 1890 (6094) the feed tube is cut with a number of transverse slits to render it flexible. Fig. 44 shows a longitudinal section of the nib socket, which is

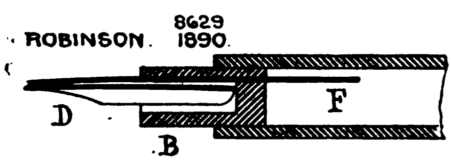
FIG. 44.



formed with openings for the nib, D (as shown in cross section). A feed tube, G, and an opening, E, for the admission of air. A longitudinal slit is provided immediately over the nib for the delivery of ink.

The reservoir in Robinson's patent of 1890 (8629), shown in Fig. 45, is provided with a plug, B, adapted to hold the nib, D. This

FIG. 45.



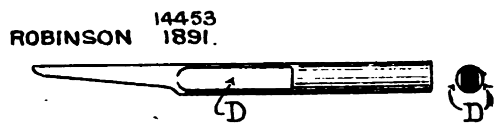
plug is provided with a groove above the nib, and in which is placed a wire or strip, F, flattened at the end in contact with the nib. A filling piece is placed in the groove, so that ink flows only in the narrow space between the wire and the surrounding walls.

In Shaw's patent of 1891 (6398), the reservoir is closed at one end, and has two openings at the other for the inlet of air, and for the outlet of ink, respectively. The lower, or penholder part, screws on the reservoir, and has openings corresponding to the inlet and outlet openings. It is hollowed out to receive the nib part. The nib is covered with a plate, between which and the nib the ink flows, air entering at an opening provided.

In theinvention of Krulis and Adutt of 1891 (3523), the ink is contained in the reservoir, and flows to the nib through a tube. This tube may be carried by the valve carried on a rod fixed to a plug fitted in the upper end of the reservoir. An elastic rubber plug or spring forces the plug outwards, and thus keeps the valve normally closed.

Mr. Robinson (1891, 14453) has here designed a feed bar of solid construction, formed with two flattened surfaces as shown in Fig. 46, at D, one on either side, to allow of the passage of ink from

FIG. 46



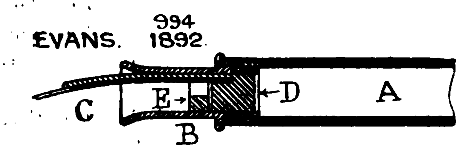
reservoir to the nib. Mrs. Robinson has to-day kindly handed me a pen which Messrs. Harmsworth produced under the name of "Answers" pen, and the feed bar now shown appears to be identical with that of this pen. It is interesting to note that the "Answers" pen was designed by Mr. Robinson in response to Messrs. Harmsworth's offer of a five-guinea prize for the best new invention, and he was successful in winning the prize.

Another pen is the invention of A. Theodorides in 1891 (17053). In this case the reservoir consists of an india-rubber bag closed at one end, and having a rigid bent nozzle at the other, so adapted as to be in contact with the underside of the nib. In the outer case is an aperture through which the reservoir may be compressed by the finger when the nib requires a fresh supply of ink.

The feed bar shown in Fig. 47, T. W. Evans, 1892 (994), is of simple construction. A the ordinary reservoir, having a point section, B, screwed into it. A nib, C, of ordinary form, is held in grooves in the point section,

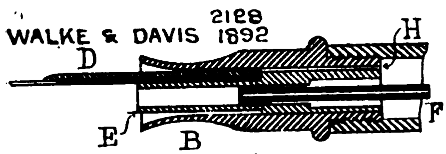
and further kept in place by the plug, E. The solid plug, D, with its projecting beak or tongue, serves as a feeder for the ink from the reservoir to the nib, small passages (not shown on the drawing) being formed at its side for the purpose.

FIG. 47.



In Fig. 48, 1892 (2128) is shown the feed arrangement of Walke and Davis. Air tubes, E and F, are fitted within the point section, B. The tube, E, is wide at the upper part to fit the bore, B, and of less diameter at the lower part to receive the nib and ink conductor, D. A

FIG. 48.



groove, H, is formed in the tube, E, to allow ink to flow to the conductor. Within the tube E, is fitted the adjustable tube, F, having a small bore for the gradual admission of air to the reservoir.

A piston of peculiar construction is used in the pen shown in Fig. 49 (3325, Blake, Pratt and Taylor, 1892). It is formed of a tube, B, having a longitudinal slit or saw cut, and filled with india rubber to render it elastic and form a tightly-fitting joint. Attached to the piston is a casing, G, which slides with the piston. The feed tube, C, is fitted with a valve, V, to regulate the ink flow, and with a mid-feather, F, to feed the ink to the nib.

In Fig. 50, L. Lowenstein, 1892 (17393), the tube, A, is formed with internal screw threads at each end. In the lower end two plugs, B and C, are screwed. One plug B has two holes, and a conical projecting portion, E, which enters the opening in the plug, C. The position of the lower plug, C, can be altered by means of a milled head, O, and the amount of opening thereby regulated. Ink flows to the nib, N, through a passage provided. An air inlet is arranged at the upper end of the reservoir, so that when the cap, T, is slightly unscrewed air may enter through the channels formed in the plug, P. To fill the pen with ink, the plug, P, is removed.

In the invention of W. Higgs, patented in December, 1892 (23632), the ink reservoir consists of a rubber bag contained in the body of the pen, and attached at its mouth to a cylindrical piece, and at the other end to a revolving plug. The pen is filled by twisting the plug, and with it the rubber tube, so as to expel the air. On immersing the point in ink and reversing the twisting action, ink is drawn into the reservoir.

In Fig. 51, Leary and Callahan, 1893 (13092), A, is the usual ink reservoir, and B, is the point section, having a nib holding section, C. The nib passes through the hole, and is attached to the spiral spring shown coiled within, B, the end of which passes upwards through an opening in the butt end of the nib, and then passes down its back, reaching to the slit. When the cap, D, is placed over the point, the nib impinges upon the swivelling

FIG. 49.

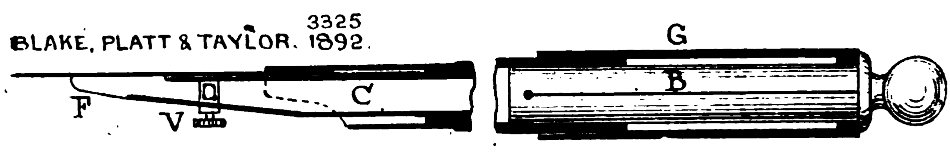


FIG. 50.

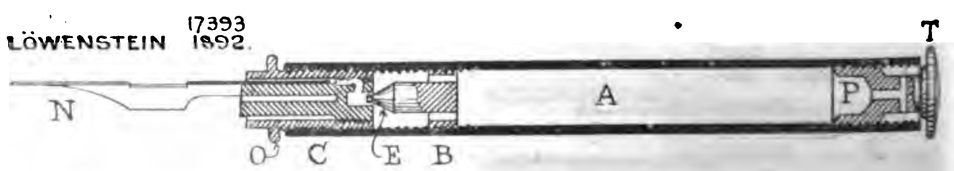


FIG. 51.

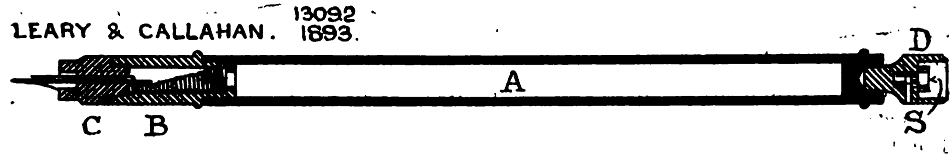


FIG. 52.

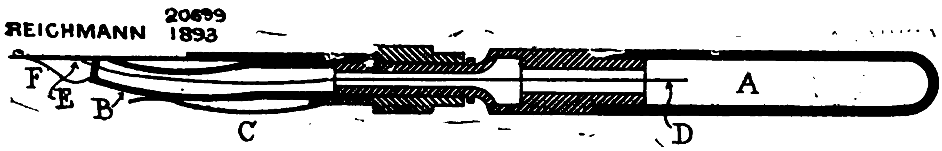
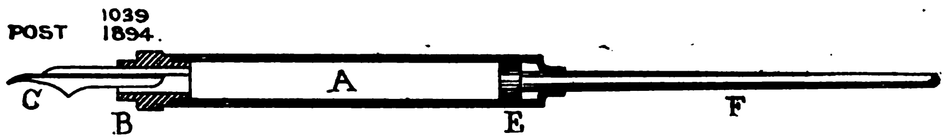


FIG. 53.



part, S, and is forced backwards against the pressure of the feed spring, which projects the nib into the forward position when the cap is again removed.

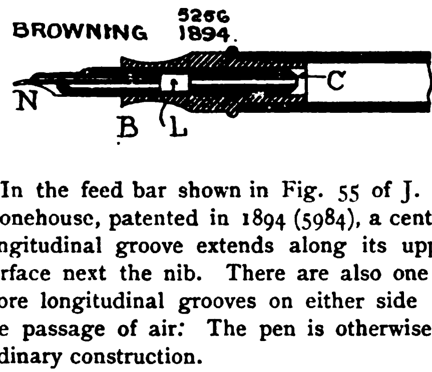
J. E. Chase, in 1893, patented a pen in which the nib is permanently attached to a rod by a rivet. The chief feature of this pen lies in the arrangement whereby the nib is made to recede when out of use.

The pen shown in Fig. 52, E. Reichmann, 1893 (20699), the inventor states, is for use with any form of steel nib. The reservoir, A, communicates with the flexible tube, B, which is pressed against the nib, F, by means of the spring, C. A wire, D, extends from the reservoir, A, through the tube, B, and terminates at E, and thus conveys ink to the nib, F.

The body, A, of the pen shown in Fig. 53 W. Post, 1894 (1039), contains a plunger or piston, E, attached to a rod or handle, F. The nib, C, fits into grooves in the point section, B. The body, or reservoir, A, is filled with ink by operating the plunger, E. The original pen as described in the patent specification, shows the rod, F, as one piece, but the pen as now made has a telescopic rod, which reduces the length of the complete pen.

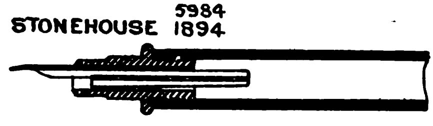
Fig. 54 shows a section through the ink feeding arrangement of C. E. Browning, 1894 (5256). The feed bar, C, is formed in one piece, and fits into the nozzle or point section, B. The nib, N, is held between the upper and lower tongues as shown, and projects backwards into the ink chamber, L, which communicates with the ink reservoir by the side ducts. Grooves on the inner surfaces of the tongues communicate with the air passage, which runs centrally through the feed bar. This pen was introduced by Mr. Robinson as the "Regal."

FIG. 54.



In the feed bar shown in Fig. 55 of J. H. Stonehouse, patented in 1894 (5984), a central longitudinal groove extends along its upper surface next the nib. There are also one or more longitudinal grooves on either side for the passage of air. The pen is otherwise of ordinary construction.

FIG. 55.



The invention, D. Arriaza, 1894 (9220), illustrated in Fig 56, relates to a pen in which a solution of solid ink is used to write with. The pellets of ink are stored in the receptacle, B. One or more of these pellets are placed in the reservoir, A, into which water is introduced.

The internal reservoir G, is of flexible rubber tubing, and by exerting a slight pressure on the stud F, ink is forced along the tubes, D, and an ink conductor to the nib, H. When the pen is out of use the cap, E, is pushed backwards so as to cover the opening in the feed tube, D,

The feed bar, F. C. Brown, 1894 (10838),

FIG. 56.

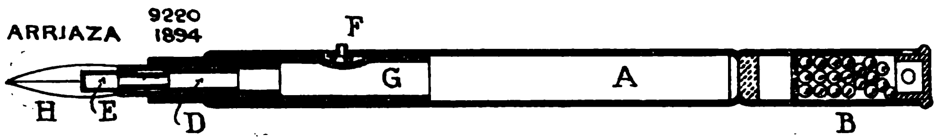
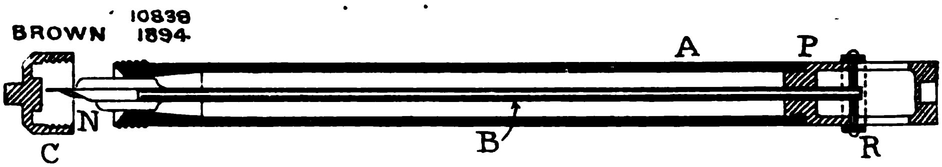


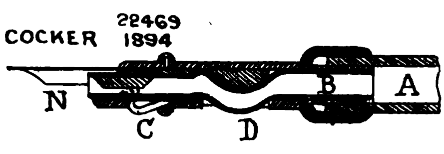
FIG. 57.



in Fig. 57, carries the nib N, between two tongues, and it extends rearwards in the form of a rod, B, through the plug, P, which is screwed into the other end of the ink reservoir, A. When the pen is out of use the nib is drawn into the nozzle of the reservoir by means of the sliding ring, R, attached to the rod, B. The cap, C, is then screwed on the front end, forming an air-tight joint, and preventing leakage of ink when carried in the pocket.

In Fig. 58, F. S. Cocker, 1894 (22469), shows another adaptation of the flexible reservoir to force the ink to the nib. It will be seen that the flexible tube, B, extends from the lower end of the ink reservoir, A, to the feed bar, a short portion of it projecting on the underside of the penholder. By pressing this portion, D, ink is

FIG. 58.

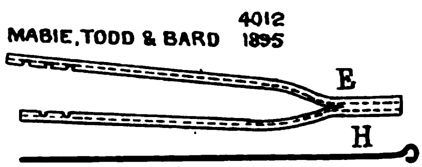


expelled to the nib, N. When the pen is out of use, a cap is pushed over the nib and front end of the penholder, forcing a bent piece, C, upwards, thus closing the ink outlet.

As everyone knows, Fig. 59 is a drawing of the feed bar of the well-known "Swan" Fountain Pen (1895, 4012, Mabie, Todd, and Bard), patented ten years ago. A flexible tube, E, is split for the greater portion of its length, and the legs bowed apart as shown. Notches are provided at the end of each leg. The nib is held between the two legs. The grooves in the legs which originally formed the bore of the tube, E, serve to carry ink to the nib and air to the ink reservoir, assisted by the bright surface of the wire, H, running through the bore of the tube.

A patent was granted in April, 1895, to J. Glass (7199), for a fountain penholder having a

FIG. 59.



flexible rubber ink reservoir, terminating in a tubular glass ink feeder. By pressing the flexible reservoir on the surface visible through the opening in the outer protecting casing, ink is made to flow to the nib.

The nozzle or point section, B, in Fig. 60. W. W. Stewart, 1895 (13566), is screwed into the ink barrel, or reservoir, A. The thickened end of a stopper bar, F, fits into the end of the nozzle eccentrically, leaving a crescent-shaped opening into which the nib, C, is inserted, and held firmly by the top feed bar, D. Ink flows down to the nib and through openings around it as shown. The stopper bar, F, is hollow and slit longitudinally to establish ink communication between the nib and the reservoir. The bore of the bar, E, is partly filled by a wire, F, having a spherical knob on its outer end, by means of which the feed may be adjusted.

In Fig. 61, H. Brams, 1896 (1029), the ink is contained in the flexible rubber bag or reservoir, C, and supplied to the nib through the upturned opening, D. An outer metal case protects the reservoir, and has an opening at F, whilst a plate, E, extends all along the parallel portion of C, between it and the cover. The cap is formed with a blunt point which when inserted in the hole, F, forces the plate, E, against the reservoir, C, thus compressing it. On its release a supply of ink may be drawn into the reservoir.

along a spiral groove to the neck, and thence along other grooves filling pockets, which are connected in pairs by holes, and it finally passes along the feeder to the nib.

Fig. 62, W. Schlomberg, 1896 (25441), shows yet another piston-action pen. The reservoir is filled with ink by withdrawing the hollow tubular plunger, C, the point, G, having been immersed in ink. On covering the outlet, G, and opening the air inlet, I, the plunger may be pushed into the barrel, A. The ink guide, H, is then replaced in the orifice, G, as shown

FIG. 60.

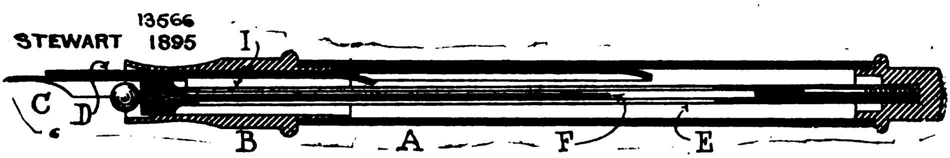


FIG. 61.

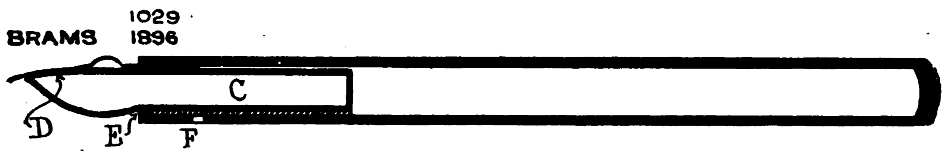


FIG. 62.

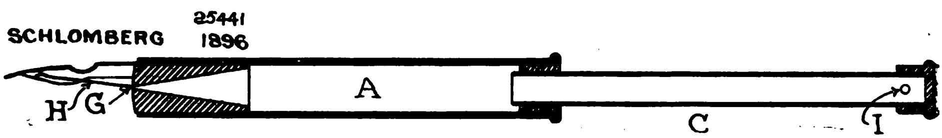
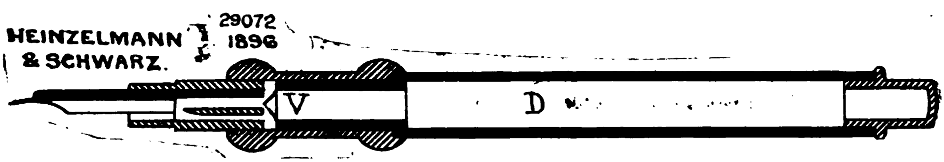


FIG. 63.



This invention, I. Golwer, 1896 (2189), relates more particularly to the method of controlling the supply of ink to the nib. The ink is contained in the back part of the holder and passes forward through the tube. By depressing the rear end of a lever the valve is raised, and ink flows outwards along the feeder to the nib.

In another pen, C. J. Renz, 1896 (16733), ink is contained in a reservoir, having an air inlet at its upper end. The ink outlet is opened by pushing back the ink conducting piece, thus moving a valve from its seat. Ink then flows in such a position as to conduct the ink to the nib.

The pen shown in Fig. 63 (29072, Heinzelmann and Schwarz, 1896) has a valve, V, of conical form and two or more channels for the ink, which may be partially or completely closed by screwing in the part, D, which is formed at its lower end to fit V.

The specification of this inventor, E. Reisert, 1897 (924), shows a variety of forms of feeding arrangements, from which I have selected as an illustration the one shown in Fig. 64. An intermediate chamber, A, formed

of flexible rubber, is placed between the ink reservoir, I, and the nib, N. It is connected with the reservoir by a tube, E, having a valve opening downwards, and at the lower end it is connected with the nib by a tube, O, having an opening at its side which is normally closed by the spring valve, S, opening outwards. In use the flexible chamber, A, is lightly pressed so that the valve, E, is closed and the valve, S, is opened, thus forcing a supply of ink to the nib. On relieving the pressure the valve, S, automatically closes, and valve, E, opens, admitting a fresh charge of ink to the chamber, A.

Fig. 65 (Bryant and Townsend, 1897, 11516) is a self-filling pen, similar in some respects to others. When sufficient ink has been drawn into the reservoir by the withdrawal of the glass tubular plunger, D, it is allowed to flow into the hollow plunger, which is then pushed downwards into the holder. The ink passages between the reservoir and the nib, C, are not shown, but I would call attention to the annular passage at the bottom of the reservoir being completely closed by the plunger, D, thus making the pen safe to carry in the pocket without fear of leakage, the plunger being firmly screwed down by means of the cap, K, to which it is secured.

Another inventor essays to produce a piston pen (W. C. Sherman, 1897, 19760). The piston is operated by a sliding case connected to the piston-rod which is screwed into the plug at its upper end.

In Fig. 66 (A. Oidtmann, 1897, 20199), the nib, C, is held in place by the elastic ball, F, which entirely closes the ink outlet when the nib is withdrawn. The nib is provided with grooves which conduct the ink to the point.

FIG. 64.

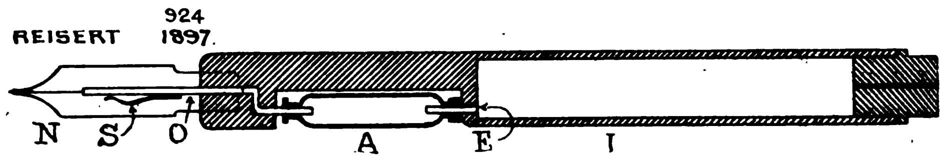


FIG. 65.

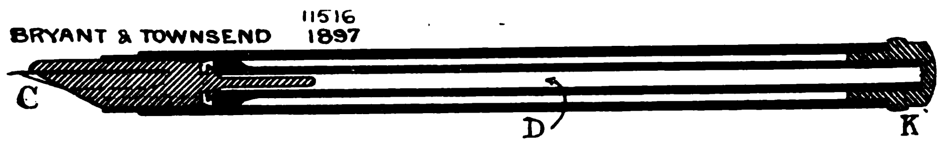


FIG. 66.

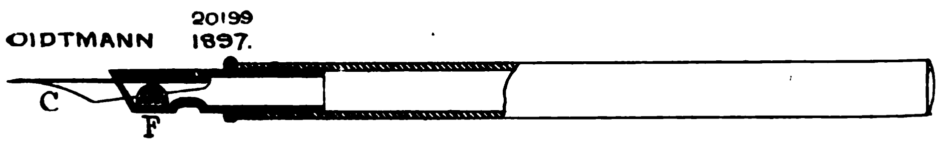
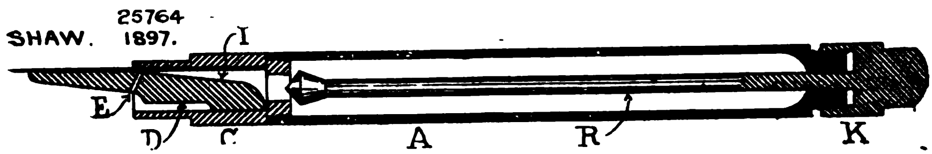


FIG. 67.



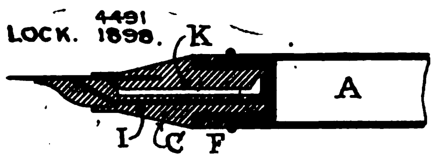
Another pen, Sugden and Wild, 1897 (21948), is one in which the ink is forced to the nib as required. The screwed piston rod carries a pin which slides in a slot. By rotating one part on the plug, the piston is advanced, and forces ink through the feeder to the nib.

Fig. 67 (W. T. Shaw, 1897, 25764) shows a pen in which the reservoir, A, is fitted with a screw plug or point section, C, into which is fitted a second plug, D, having an ink duct, I.

and an air inlet, E, between the points of which the nib is held. The rod, R, may be screwed down by means of the cap, K, so as to completely close the ink passage.

The drawing, Fig. 68 (G. H. Lock, 1898, 4491) is that of the feed point in section. The ink-holding tube, A, is closed by a disc having holes as shown. The plug, C, is provided

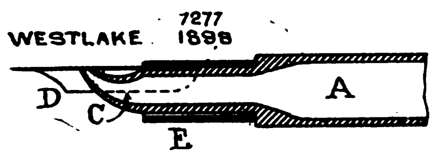
FIG. 68.



with an air channel, I, and and an ink duct, K. This plug can be rotated in the collar, F, so that the holes, by a hit and miss arrangement, become covered, thus either cutting off, or allowing the flow of ink as desired.

The ink reservoir in Fig. 69 (S. N. B. Westlake, 1898, 7277) is closed at one end by a screw plug, and supplies ink to the nib, D,

FIG. 69.



through the curved duct, C. The nib is held beneath the loose sleeve, E. The essence of simplicity certainly, but probably its simplicity is fatal to its satisfactory working.

This pen (Weeks and Morch, 1898, 12244), is designed so that the supply of ink to the nib can be cut off by rotating the head, thus raising the piston, and bringing the valve tight against its seat. Wires are attached to the nib, and extend slightly behind it, and by their vibration are intended to prevent clogging of the channel with ink.

(To be concluded.)

INDUSTRIAL EXHIBITION IN BAVARIA, 1906.

There is to be held in Nuremberg, from May to October, 1906, a general industrial, trade, and art exhibition of the Kingdom of Bavaria. Similar exhibitions, but on a smaller scale, have already been held in that city in the years 1882 and 1896, and they were both attended with great success. The forthcoming exhibition will be held in commemoration of the fact that next year will be the one hundredth anniversary of the raising of Bavaria, hitherto an Electorate, to a Kingdom. It was Napoleon I. who raised Bavaria to the rank of a Kingdom, enlarging it at the same time by important additions of territory, thus showing his gratitude to the Bavarians, his allies at that time, in his war against Austria. According to the American Consul at Nuremberg, the proposed exhibition will be held under the protectorate of Prince Regent Luitpold, the present ruler of Bavaria, and is to give a complete view of all the resources, productions, and industries of the kingdom, which at present has a population of 6,500,000 inhabitants, and an area of 29,343 square miles. The exhibition is to be about forty minutes' walk from the centre of the city, in a newly laid out public park, with a lake adjoining it, and will cover an area of 336 acres, of which half is taken up by the lake itself. The exhibition promises to be a very important one, and according to the Consul is likely to present much of interest to visitors, as there are many articles of manufacture in which Bavaria excels, and which are exported to all parts of the world. Principal among these are toys, lead pencils, and bronze powder. Then plate and window glass and mirrors, lenses, gold and silver trimmings, gloves, glassware, iron and tiled stoves, sewing machines, artistic manufactures in ivory and iron, majolica and faience articles, pianos, guitars and zithers, baskets, coloured gold and silver paper, papier maché goods, altar furniture, flags, banners, embroideries, stained and painted glass windows for churches, &c. The beer breweries of Bavaria have a world-wide reputation, and therefore all apparatus and machinery in the manufacture of the same will be on view. The art department also is expected to be of great interest, Munich being the great art centre of Germany. Very interesting collective exhibits will be made, as for instance, furnished rooms, showing wall, ceiling, and floor decorations, with furniture, curtains, stoves, mirrors, &c. Then the Bavarian Government, the city of Nuremberg, and various other administrations, will make collective exhibits of articles and appliances connected with postal, telegraphic, military, educational, sanitary, and municipal institutions.

MINES AND MINING IN MANCHURIA.

It is known that there are valuable mineral deposits in Manchuria. Coal has been mined for several years in a primitive way, and the operations of the Russians in this direction attracted attention near Mukden. Gold, both in quartz and placer, is found, as is copper, silver, and other minerals; but, as the American Consul at Niuchwang points out, exactly what the

field offers in the way of practical mining possibilities is as yet subject to careful investigation. Many agree, however, that Manchuria is one vast field of mines, and rich farming and grazing lands. Indeed, some of the samples of ore promise great results, but, as a rule, the question which enters into the operation of, and as yet, indeed, the securing of title to, good properties is indefinite and too nebulous at this particular time to prove attractive to capital. With war at an end, and ample and well-defined Government regulations in force, the exploitation of mining enterprises must be open to serious examination. The indications of croppings appear to warrant thorough prospecting of undeveloped properties, and expert opinions, where capital seeks investment in mines that have a right to be called such. Manifestly all matters pertaining to the development of mining properties are practically at a stand-still in Manchuria. In many parts of China, as well as in various other countries, there exists a belief that the mineral deposits of Manchuria are fabulously rich. This belief may, in part, be accounted for by the popular idea that an unknown mineral or gold district possesses great wealth. Previous to the present war, several coal, and a number of gold quartz prospects, held out great inducements, although the Chinese, in a primitive way. have for years been taking gold out of the country. As a rule, however, there has been comparatively little scientific prospecting or investigation. With favourable conditions following the war, the mineral resources of Manchuria will, no doubt, warrant thorough prospecting; without favourable conditions foreign capital probably will be invested with great caution. Applications for mining concessions covering apparently valuable areas in Eastern Manchuria have been put aside for the time being, for one reason or another, but in the main on account of the war. The natives are doing some prospecting, mining, and development work in Manchuria, but foreigners are not thus engaged. The war temporarily at least paralysed mining enterprises. However, it may be said that the samples of ore exhibited at Niuchwang and elsewhere in Manchuria indicate the presence of highly valuable deposits in the various minerals, with several, such as iron, coal and copper, in similar districts covering wide areas. Galena ores recently assayed show, for instance, 1·14 ounces in gold and 1·18 in silver per ton. Various quartz samples assayed showed an average of 0·54 ounces in gold, and as high as 1·25 ounces in silver. Most of the coal has an abundance of slate and ash, although coal of a good qnality has for years been mined in a small way in the Liao Peninsula district. Twenty years ago, for instance, foreign residents in Niuchwang brought their winter's coal supply from the partially-developed mines of Manchuria. Some of these mines have been filled with water, and others have been temporarily abandoned. This coming winter, it is probable that the bulk of the Manchurian coal supply, for domestic purposes, will come from Japan or elsewhere in the Far East.

HOME INDUSTRIES.

The Record Hop Crop.—With the one exception of 1886 the hop crop of the present year is larger than that of any year since the official figures relating to production were first collected in 1885. In 1886 the crop yielded 776,144 cwt., this year it is given at 695,943 cwt., but whereas in 1886 the area under cultivation was 70,127 acres, and the yield per acre 11·07, this year the average was only 48,968 acres, and the yield per acre is 14·10, by far the highest yield on record, the highest hitherto having been 12·76 in 1894, when the total crop was only 661,373 cwts., from an acreage of 51,843. The bad weather this year at ingathering time caused a large proportion of the crop to be more or less off colour, but a third of it is of first-rate quality, and the crop having been grown in a healthy state the off-coloured samples are, from the brewers' point of view, good healthy hops, and full of condition. As the annual consumption of hops for the whole of the United Kingdom ranges from 600,000 to 650,000 cwts. no foreign consignments will be required during the ensuing year. Last year the home yield of hops was only 282,330 cwt., and the value of the hops imported was no less than £1,839,854, the largest sum paid for foreign hops since 1882 when the imports were valued at £2,962,631.

Hop Prices and Profits.—It might be thought that the unprecedented yield of the present year, along with the fair condition of the hops when harvested, would mean very large profits for the hop growers, but this by no means follows, as was shown in the *Journal* of September 1st last. Indeed many of the growers are saying that the last part of their growth has not paid for labour, and a good many are dissatisfied and threaten to root the plant up. Without attaching overmuch importance to grumblings of this kind the following comparative prices, which represented quotations for hops a few days ago—and having been adjusted and revised by the Borough merchants they are not likely to alter materially are suggestive :—

	1904.						1505.					
	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.
East Kent Goldings	9	10	10	10	11	10 ...	2	0	2	16	4	0
Mid Kents	9	0	10	0	10	10 ...	2	0	2	10	3	15
W. of Kents	8	15	9	9	10	0 ...	1	15	2	5	3	10
Sussex	8	15	9	0	9	15 ...	1	15	2	5	3	0
Worcesters.	9	0	10	0	11	0 ...	2	0	2	10	3	10

These figures show an enormous drop from the prices of last year. The lowest price on record was that of the bumper crop of 1886, but even then it only fell to £2 18s. 6d. "Now," to quote from the circular of a well-known hop firm, "good, thick, fat, copper hops are to be got at sixpence per lb. and under." Even a yield like the present one of 14·10 cwts. per acre would only just cover cost of cultivation at £2 16s. per cwt.

Indian and Home Beers.—India has always been one of the chief markets for British beer, but it looks as if our brewers will have to reckon with serious shrinkage in the Indian demand before long. According to a memorandum issued by the Board of Trade through the Indian Office, India is increasing her home production of beer. In 1904 the quantity of beer brewed in India amounted to no less than 6,219,761 gallons, of which 46 per cent. was bought by the army commissariat. There are already 27 breweries of which one at Delhi did not work. All are private property except six, which are owned by five joint stock companies with nominal capital Rs. 24·80·000, of which Rs. 23·89·110 was paid up at the end of 1904-5. Twelve of the breweries are situated at stations in the Himalayas from Murree to Darjeeling, and much of the beer is brewed there. A large quantity is also brewed at Lucknow, Rawalpindi, Poona, Bangalore, Jubbelpore, at and near Ootacumand, and at Quetta and Mandalay. The largest of these breweries is at Murree, the Kassanti and Poona breweries standing next. More than one-third of the whole output is brewed in the Punjab. The exports of beer from the United Kingdom to India in the nine months ended September 30, 1905, show but a very slight falling off as compared with the corresponding period of last year, and over 93 per cent. of the beer imported by water comes from the United Kingdom, but the total imports represent little more than two-thirds of the quantity brewed in India. There would seem to be no good reason why the percentage of Indian brewed beer should not increase.

Brandy v. Whisky.—If the brewers have to keep a watchful eye upon their Indian trade, another home industry finds itself confronted with a change of taste, or fashion, that has checked exports. Until some thirty years ago the favourite spirit in India was brandy, which then gave place to whisky, much to the advantage of a home industry. But recently there have been signs of a return to the old preference, and the figures for 1902-3, 1904-5, show that this change is becoming marked. The proportions imported were (gallons):—

	1902-3.	1903-4.	1904-5.
Whisky	610,327 ..	606,805 ..	589,474
Brandy	322,167 ..	363,359 ..	372,723

Including liqueurs and methylated spirit, the spirits imported into India last year amounted to 1,473,798 gallons, of which 772,350 came from the United Kingdom. The potable spirits imported from other countries are chiefly arrack from Ceylon, rum from the Straits, and gin from Holland.

CORRESPONDENCE.

INCANDESCENT GAS AND ELECTRICITY.

I notice in recent numbers of the *Journal* that under the title of "Home Industries" some remarks have appeared relating to incandescent gas and electricity, and trust you will allow me to suggest that the claims of the advocates of lighting by incandescent gas have not been sufficiently proved to justify the remark contained in the notes that "Electric companies have found a formidable competitor in both house and street lighting in incandescent gas."

Mention is made of the experiments in the street lighting now being carried out by the Corporation of the City of London, and as any reticence regarding the actual facts of the case may give the impression that the merits of the respective methods of illumination are being decided under similar conditions and with equal facilities, I must ask you, in common fairness, to give publicity to the fact that the Corporation of the City of London are apparently giving some preference to a gas company and compressed gas lighting without offering any facilities or making any attempt to ascertain the value of modern electric arc lighting.

The existing arc lighting of the streets of the City is carried out by means of appliances about fifteen years old, and therefore not of the best modern description, and the lamps are also placed in antiquated and extremely ugly lanterns designed by the late engineer to the Corporation, who insisted on their use. These lamps, standards, lanterns, and mains, were supplied free of cost by the Lighting Company, and the charge for maintaining the appliances and lighting was therefore assessed to cover some interest on the capital involved, which was extremely heavy on account of the requirements of the Corporation that the whole of the lighting should be carried out promply and without waiting for the completion of the lighting network of mains. In the case of the gas lighting, however, the Corporation have paid the whole of the capital cost involved; and in spite of this fact the actual cost of lighting by electric arcs works out at about 5d. per candle power per annum as compared with 11d. for gas.

The effective illumination of the two methods can easily be judged by any observer, and it will be found that whereas the electric arc enables the general illumination of the street to be carried out, the use of a short lamppost with an incandescent burner limits the illumination to a confined space round the post, and while useful as indicating the position of the kerb and pavement, such lighting is of no service in obtaining the illumination of the thoroughfare. Such luminous points, even when they are numerous, fail to secure what is really wanted, and that is a sufficient illumination of a street to enable the police to protect the interest of the citizen. If any doubt can be imagined on this point, let an observer visit the Mansion House, where he will see one of the largest compressed gas lamps in operation thrown completely in the shade by the example of modern arc lighting, the cost of running this abnormal gas lamp being something like £65 per annum, without any addition for interest on the capital outlay, and as the light given by this gigantic lamp is only about

900 candles, the cost, without capital charges, works out at about 17d. per cp. per annum.

With these results before us, it is not surprising that many places, including the Deptford Cattle Markets, have thrown out all incandescent gas in favour of the electric arc.

FRANK BAILEY.

Bankside, London, E.C.
31st October, 1905.

GENERAL NOTES.

SOUTHERN NIGERIA.—Summing up the condition of the people of Southern Nigeria (Cd. 2684), the High Commissioner (Mr. Egerton) writes, "The people are typical of the country, in that they are mentally undeveloped, and afford an enormous field for the efforts of the pioneers of civilisation. They are free from direct taxation; they live in comfort, and have few or no cares. On the whole, their lot is a happy one." It would seem so, nor is it certain that they will be grateful for the introduction of a civilisation which, as Mr. Egerton says, "will undoubtedly make the life of the native more strenuous as it becomes more luxurious." Be that as it may, Southern Nigeria is doing well. Mr. Egerton believes the history of the Protectorate to be "unique both for Africa and for other portions of the British Empire. Throughout the whole of the country now under our control settled government has only been established by means of a show of military force, and yet the whole cost of introducing and maintaining law and order—involving the maintenance of a large military establishment—has been defrayed from the local revenues, without incurring any debt. As each year, a larger area has been pacified, a proper system of justice established, free trade between town and town and the coast rendered possible, the increasing revenue has enabled a further area to be similarly dealt with in the succeeding year. In addition to this, large sums have been annually contributed towards the cost of the administration of Northern Nigeria." There seems to be plenty of rain in the Protectorate—the average for the four stations at which records were kept, was 146·87 inches; the highest being at Bonny with 182·84. Road-making is the great want in opening up the country and so breaking down the old barriers of enmity and distrust which have so long existed to the detriment of commerce and the spread of civilising influences.

THE STRAITS SETTLEMENTS.—The figures given in the Governor's Report on the Straits Settlements (Cd. 2684) as to shipping are very striking. The total tonnage entered and cleared in 1904 amounted to 18,267,499 tons. Of this the British flag covered 11,842,744 tons. The foreign tonnage to and from Singapore alone was 12,331,753, Penang taking most of the remainder, 5,180,574. Next in importance to British shipping was German, with 2,859,761 in and out. Under the head of immigration, the figures, as they relate to the Chinese, are given for the last five years and the number of women and children is noticeable. Taking 1904 the figures are as follows: —Men, 179,650; women, 14,395; children, 10,751. The number of "unpaid" passages, *i.e.* of coolies who obtain free passages from China in consideration of entering into contracts for service on arrival in the colonies, has fallen to 16,930. In the last ten years, only two years—1897 and 1898—have shown a lower figure. A few Para rubber estates were started recently on the island, but it is not expected that they will increase to any great extent, as there is not much land suited for this cultivation. In Province Wellesley, and Malacca, however, there is a marked increase in rubber cultivation, and still more so in the Federated Malay States. The area under cultivation in the Peninsula is very large, and the prepared rubber is in great demand by home manufacturers, the best samples having taken the highest price ever paid in 1904, viz., 6s. 1½d. per lb. Indigo cultivation has dwindled to a few fields, and very few of the dyeing houses now remain.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 6...Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Sherard Cowper-Coles, "The Metallic Preservation and Ornamentation of Iron and Steel."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Dr. J. Lewkowitsch, "Evaporation in Vacuo of Solutions containing Solids."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Rev. Walter Weston, "Travel in the Mountains of Central Japan."

British Architects, 9, Conduit-street, W., 8 p.m. Opening Address by the President, Mr. John Belcher.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. M. Flinders Petrie, "The Egyptians in Sinai."

TUESDAY, Nov. 7....Civil Engineers, 25, Great George-street, S.W., 8 p.m. Sir Alexander Binnie, "Presidential Inaugural Address."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Dr. J. A. Voelcker, "Chemistry in Relation to Horticulture."

WEDNESDAY, Nov. 8...Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. Narinori Okoshi, "How the Nikko Temples were Built."

United Service Institution, Whitehall, S.W., 3 p.m. Mr. H. E. Leigh Canney, "The Toleration of Enteric Fever by the Army."

THURSDAY, Nov. 9...London Institution, Finsbury-circus, E.C., 6 p.m. Sir Alexander Mackenzie, "Tchaikowsky."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Inaugural Address by the President, Mr. John Gavey.

FRIDAY, Nov. 10...Physical, Royal College of Science, Exhibition-road, South Kensington, 8 p.m. (1) Mr. James Swinburne, "The Question of Temperature and Efficiency of Thermal Radiation." (2) Mr. T. H. Blakesley, "Note on Constant-Deviation Prisms."

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No. 2,764. VOL. LIII.

FRIDAY, NOVEMBER 10, 1905.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One Hundred-and-Fifty-Second Session will be held on Wednesday Evening, the 15th of November, when an Address will be delivered by SIR OWEN ROBERTS, M.A., D.C.L., F.S.A., Vice-President and Chairman of the Council.

Previous to Christmas there will be Six Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section. The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 15.—Opening Address of the CHAIRMAN OF COUNCIL.

NOVEMBER 22.—"The Cinematograph and its Applications." By F. MARTIN-DUNCAN. DR. H. E. ARMSTRONG, F.R.S., will preside.

NOVEMBER 29.—"The British Association in South Africa." By SIR WILLIAM H. PREECE, K.C.B., F.R.S.

DECEMBER 6.—"The Manufacture of Sugar from British Grown Beet." By SIGMUND STEIN.

DECEMBER 13.—"The Commerce and Industry of Japan." By W. F. MITCHELL. HIS EXCELLENCY THE JAPANESE AMBASSADOR, will preside.

DECEMBER 20.—"The Aerograph Method of Distributing Colour." By CHARLES L. BURDICK.

Papers for meetings after Christmas:—

"London Traffic." By CAPTAIN G. S. C. SWINTON (L.C.C.).

"The Preparation of Oxygen from Liquid Air." By MONSIEUR RAOUL PICTET.

"Submarine Signalling." By J. B. MILLET.

"The Supply of Electricity." By JAMES N. SHOOLBRED, B.A., M.Inst.C.E.

"The Planting of Waste Lands for Profit." By J. NISBET.

"Industrial Russia." By LUCIEN WOLF.

"The Horseless Carriage, 1885-1905." By CLAUDE JOHNSON.

"The Artistic in Painting and Photography." By J. C. DOLLMAN.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 7.—"The Partition of Bengal." By SIR JAMES A. BOURDILLON, K.C.S.I.

December 7, January 18, February 15, March 15, April 26, May 24.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

February 6, March 6, April 3, May 1.

APPLIED ART SECTION.

Tuesday Evenings, at 8 o'clock:—

DECEMBER 12.—"Historical Pageants." By LOUIS N. PARKER.

December 12, January 30, February 20, March 20, April 24, May 15.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

J. A. FLEMING, D.Sc., F.R.S., "The Measurement of High Frequency Currents and Electric Waves." (In continuation of previous courses on "Electric Oscillations and Electric Waves," and on "Hertzian Wave Telegraphy.") Four Lectures.

November 27, December 4, 11, 18.

SIR WILLIAM WHITE, K.C.B., F.R.S., "The Modern Warship." Five Lectures.

January 29, February 5, 12, 19, 26.

PROF. VIVIAN B. LEWES, "Fire: Fire Risks and Fire Extinction." Four Lectures.

March 12, 19, 26, April 2.

ALFRED MASKELL, "Ivory." Three Lectures.

April 23, 30, May 7.

GEORGE W. EVE, "Heraldry in Relation to the Applied Arts." Three Lectures.

May 14, 21, 28.

Howard Lectures.

A Course of Three Lectures will be given under the Howard Trust, by Professor Silvanus Thompson, D.Sc., F.R.S., on "High Speed Electric Generators, with special reference to driving by Steam-turbines," on the followng Thursday Evenings, at 8 o'clock:—January 18th and 25th, and February 1st.

Juvenile Lectures.

Two lectures suitable for a Juvenile audience will be delivered on Wednesday evenings, January 3rd and 10th, 1906, at 7 o'clock, by Professor Herbert Jackson, on "Flame and Combustion."

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

RESERVOIR, STYLOGRAPHIC, AND FOUNTAIN PENS.

By James P. Maginnis,
A.M.Inst.C.E., M.Inst.Mech.E.

Lecture III.—Delivered February 6, 1905.

(*Concluded from p.* 1189.)

In Fig. 70 (O. Winkler, 1898, 12805), the hollow ink holding pen handle, A, is by preference made of glass, and is tapered and curved at the forward end to supply the nib, N, which is held in the sliding barrel, B. The rubber air ball, C, is fitted with a sliding valve, V, to control the admission of air, and thus regulate the flow of ink.

The Eagle Pencil Company has designed (1898, 15766), some forms of feed bars, or ink-feeding plugs, as the inventor calls them, for conveying ink from the reservoir to the nib. One of these consists of a tube slotted along the top to receive a tongue, which separates it into two unequal channels.

Fig. 71 (J. Blair, 1898, 17118), shows in part section a reservoir pen in which powdered ink is used. A dry ink cartridge, C, is carried in a porous bag, covered at its forward end by a piece of sponge, S. Soft water is poured into the reservoir to dissolve the ink powder. Otherwise this pen does not call for any remark.

The pen patented by J. H. Burton (1899, 595), was provided with two ink reservoirs and two writing points. One design shows a feed bar having an ink inlet communicating by means of spiral ducts with the ink supply at the upper side, so as to be in contact with the under side of the nib. Another arrangement shows a somewhat similar feed bar provided with a screw thread engaging with the point section, and having an elongated ink duct which tapers towards the inner end, so that by screwing the piece in or out, the ink supply may be regulated.

In the drawing, Fig. 72 (E. Reisert, 1899, 2000), it is seen that the reservoir supplies ink to the nib through the flexible syphon tube, A A. The supply is controlled by pressing on the lever L, at intervals, thus closing and opening the passages at the strictures or valves, V V. Ink enters at the bottom of the reservoir and travels up the shorter limb of the syphon, and is delivered to the nib at the extremity of the longer limb.

Another pen (R. Cofani, 1899, 10869), had a flexible rubber reservoir. The nib is carried in the holder, to which is pivoted the pressure piece. Ink is contained in the reservoir, and is forced through the supply tube by the action of the pressure piece when the nib is brought in contact with the paper.

In F. C. Edgar's pen (1899, 21195), the

Fig 70.

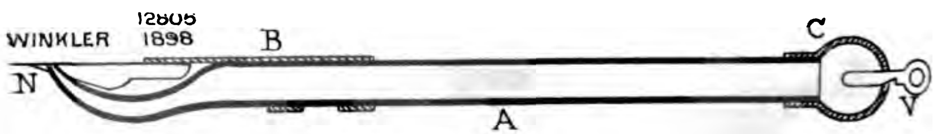
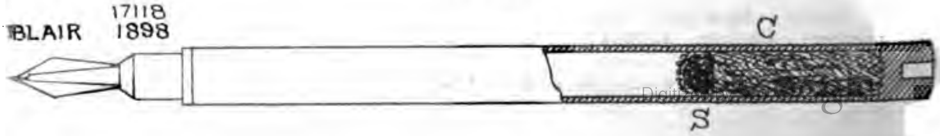


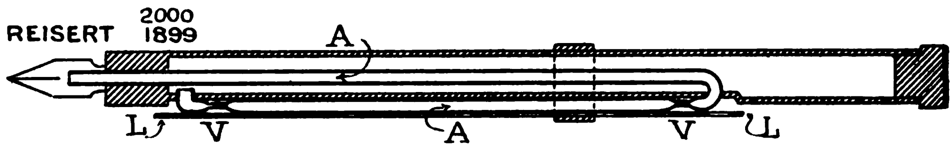
Fig. 71.



ib is held by the barrel above the elongated pening of the ink duct which is supplied from he reservoir. An outer casing protects the /hole.

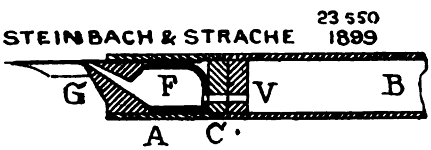
at the back of the casing, A. The ink guide, D, consists of a bent wire terminating in a flat paddle, W. The nib is held in place by the barrel, E.

FIG. 72.



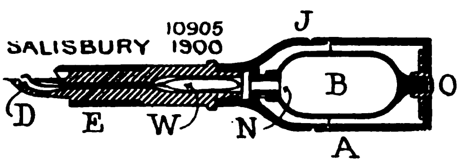
In Fig. 73 (Steinbach and Strache, 1899, 3550) the reservoir, B, and front tubular portion, ι, are screwed on the plug, C. The flexible ubber chamber, F, supplies the nib with ink, hrough the beak, G, and communicates with

FIG. 73.



he reservoir, B, by means of the eccentrically placed channels in the plug, C, and the valve, V. The nib is so secured, that when in use, its nner surface is free to move and depress the surface of the flexible rubber chamber, F.

FIG. 74.



In Fig. 74 (Salisbury, S. M. and E. C., 1900, 10905) the casing, A, is made in two separable parts, connected by a sliding joint, J. The nk reservoir, B, is made of rubber and is attached to the nipple, N, and to the steadying button which loosely fits into an opening, O,

The feed arrangement of another pen (C. J. Holm, 1900, 11049) consists of a plug, provided with a central duct, in which is inserted a short tube leading to a rubber tube, fitted with a glass mouthpiece, which delivers the ink to the nib.

The peculiarity of the pen shown in Fig. 75 (W. F. Cushman, 1900, 11580) is, that when out of use the nib may be withdrawn into the barrel as shown in the drawing. The nib is carried at one end of the spindle, B, sliding through the plug, C, and is connected by the screw-plug, G, with the sleeve, F. When the cap, H, is removed from the front of the pen, the sleeve, F, and the spindle, B, are pushed forward, carrying the nib into position for writing. This appears to be Moore's non-leakable pen.

The ink in F. E. Clarke's pen (1900, 12658) is supplied to the nib through a tube, which may be partly or entirely closed by a tapered wire secured to the screw cap.

In Fig. 76 (H. Grass, 1900, 16558), the nib, N, is shown held in slits in the block, K, and supplied with ink by the sponge or wad contained in the chamber, J. A piston valve, V, is provided at the other end with which the rear end of the ink supply tube, P, may be closed. Extra wads are kept in the upper end of the cap, N.

The nib in Fig. 77 (H. Grass, 1900, 17832), is secured in a slit in the plug, G. Ink passes from the reservoir, B, through the duct, E, and is conveyed to the nib by the spiral spring, L.

FIG. 75.

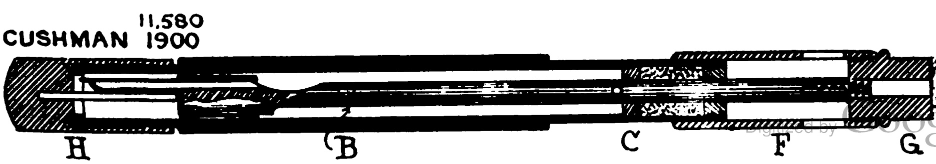


FIG. 76.

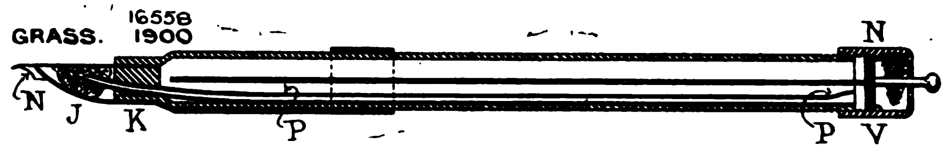


FIG. 77.

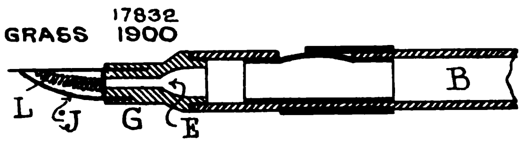
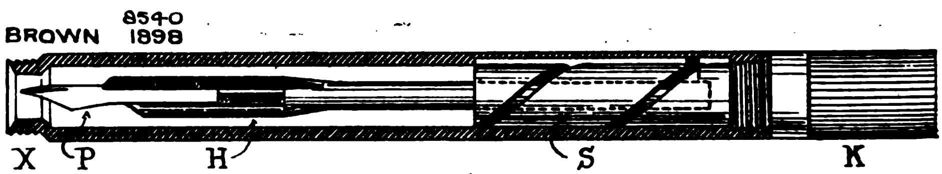


FIG. 78.



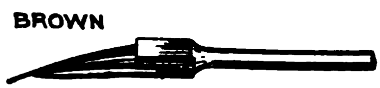
enclosed in the chamber, J. An opening is provided in the outer metallic case, so that the interior flexible rubber reservoir may be compressed slightly by the finger in writing.

In H. W. Dixon's pen (1900, 23567), the ink is sucked into the reservoir by turning the head, until the lower end of the inner tube is unscrewed from the plug. The inner tube may then be slowly withdrawn, and ink thus sucked upwards. When the reservoir is charged sufficiently, further withdrawal of the tube is prevented by wire stops, it is then inverted, and the tube may be moved back into the other extreme position

In Fig. 78 (F. C. Brown, 1898, 8540), the nib, P, is held between the upper and lower tongues of the feed bar, H, which terminates in the form of a rod. A sleeve nut, S, is attached to the cap, K, and may be rotated by it. A pin in the rod, H, fits in the groove of the nut, S, and as the latter is rotated causes the rod, H, to travel in an upward or downward direction, as desired. The nib may thus be drawn within the nozzle, and the cap provided may then be screwed on at X, making a non-leakable joint.

Fig. 79 shows the forward end of the triple feed-bar now used in connection with the pen, known as the Caw pen, and issued by Messrs. Eyre and Spottiswoode.

FIG. 79.



Having now indicated the most important features of many of the fountain pens which have from time to time been invented, I will briefly describe some of those of more modern date or at present in use.

The "Sackett" pen shown in Fig. 80 has already been described in detail. This drawing, however, shows the tongue in plan, and also a cross section of the grooved feed-bar. No further description is perhaps necessary.

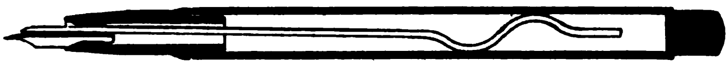
The "Quill" pen, Fig. 81, of Mr. W. S. Hicks, whose name is well known as the maker of pocket pencils, is something like the

FIG. 80.

"Wirt" (described later) as regards its feed-bar. This is, however, about treble the length of that of the Wirt pen, and terminates in a wavy form, as shown, and similar in this respect to the Sackett pen of 1886. The undulations of the feed bar are so designed that they equal the parts are made and fitted together, and the great care exercised in turning out an implement as perfect as possible.

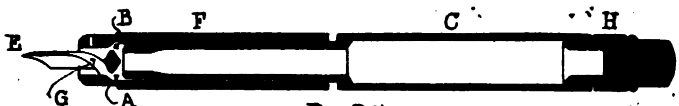
This pen (the "Lacon" pen, Fig. 83) has already been described (see p. 1181), and calls for no further comment.

FIG. 81.



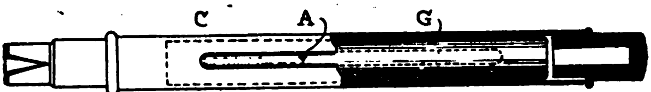
The Quill

FIG. 82.



The Pelican

FIG. 83.



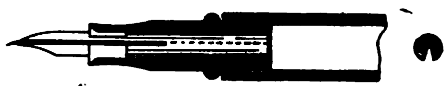
The Lacon.

internal diameter of the barrel or ink reservoir, so that in re-filling the pen with ink it is not necessary to withdraw the feed-bar completely, as the elasticity of the latter, acting against the barrel, holds it in a suitable position to permit of re-filling.

On reference to the drawing, Fig. 82 (De la Rue's "Pelican" Safety Fountain Pen), it will be seen that the holder consists of three parts, viz.:—The pen carrier, F, the body, C, and the plug, H. The body, C, is so constructed that it may be screwed into the pen carrier, F, until it closes the two apertures, A and B. By the reverse process the apertures are opened as shown in the drawing. The lower aperture, A, communicates with the duct, G, whereby the ink is led along the upper surface of the nib to the point, E. The duct, B, at the same time admits an equal volume of air to replace the ink as used in process of writing. The plug, H, is unscrewed for the purpose of re-charging the holder with ink, before doing which the apertures, A and B, must, of course, be closed as already described. By the courtesy and kindness of Mr. Evelyn De la Rue, I have had the privilege of seeing these pens made, and it gave me much pleasure to notice the accuracy with which the various

The feed bar of the "Dragon" pen, shown in Fig. 84) is partly cylindrical with a V-shaped groove extending along its under side. The front end is prolonged in the form

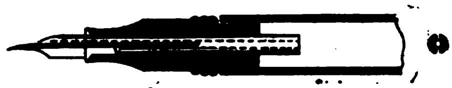
FIG. 84.



The Dragon

of a tongue which rests on the upper surface of the nib. The pen from which this drawing was made was submitted to me by the American Pencil Company. It has a tapering cap which is perhaps an advantage, as it tends to keep a better balance when writing.

FIG. 85.



The Camel

The feed bar of the "Camel" pen, of Messrs Ormiston and Glass, in Fig. 85, consists of a single rod fitting into a point section. It has

grooves and passages for ink and air as shown in the drawing. The front end terminates in a single top feed tongue, and a slit extending backwards about half way for the reception of the nib.

Fig. 86 (the "Fleet" pen) shows an exceedingly low-priced fountain pen, the specimen in

FIG. 86.

The Fenchurch. The Fleet.

my collection costing the modest sum of 6½d. It consists of a barrel or ink reservoir, B, and a plug, P, which almost fills the neck of the barrel. This plug is circular in section, cut away diagonally at the front end, to a point. A saw-cut groove extends longitudinally along its upper side, nearly to the point, whilst underneath is a cut or gash, which almost divides the plug into two parts. This latter acts mechanically as a spring, so that when the nib and plug are together placed in the barrel, both are held firmly in position. It is intended that almost any suitable form of metal or steel nib may be used, and not necessarily a gold one.

The "Lincoln" pen shown in Fig. 87 has nothing very special to speak of. It has a simple form of single undertype feed, and the

FIG. 87.


The Lincoln

pen takes its name from that of one of the most popular of the United States Presidents. I am informed by Messrs. Deverell, Sharpe and Gibson that Messrs. Perry and Co. claim the name, "Lincoln," as applied to pens of all descriptions, so that the "Lincoln" fountain pen is now known as the "Devarson," a name built up of syllables from the names of the members of the firm. Since writing the foregoing, I have tested the "Devarson" pen, and I can vouch for its excellence. The feed is simple, and effective.

Fig. 88 shows the business end of the "Stafford" pen. Like Fig. 87, and many other pens of very high excellence, it is produced in the United States. Its feed bar is a combination of that of the Waterman pen of 1884, in that it has parallel saw-cut ducts extending along its upper half, and it also resembles the feed bar of Prince's pen of 1855, in that it has a thin vulcanite tongue, a plan of which is shown on the drawing, which lies along the ink duct and vibrates with the action of the nib. The feed is very satisfactory, and I like the pen on account of its capacity for ink. Although I have fitted it with a "Swan" nib, I have found it very reliable.

FIG. 88.

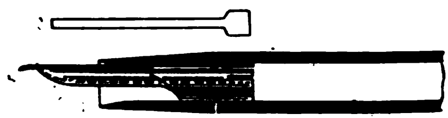
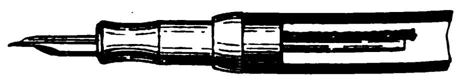

The Stafford

Fig. 89 shows the point section of the "Swallow" pen, and just enough of the feed arrangement is visible to show that it bears a very striking resemblance to that of the Swan

FIG. 89.


The Swallow.

pen of 1895. Imitation is said to be the most sincere form of flattery, and probably the maker of the Swallow pen knows a good thing when he sees it.

In Fig. 90 is shown the point of the "Parker" pen, known as the "lucky curve" pen. A saw cut commences at the rear end of the feed bar, almost dividing it in two parts, and then

FIG. 90.


The Parker

traverses the upper surface, reaching nearly to the point, where it disappears. Air is admitted through a small hole, entering at the under side, as indicated by the arrow, and passes upwards to the saw cut.

The "Swan" pen (Fig. 91) is perhaps a household word. There are those who think, or perhaps they do not think, that the name "Remington" covers all typewriting machines that ever were invented. Some firmly think that all hand cameras are Kodaks, and there are also many who no doubt think that "Swan" is a sort of generic name for fountain pens. Be that as it may, Messrs. Mabie, Todd and Bard have not been wanting in energy and painstaking ability to make the fountain pen popular. Their pens are known, and deservedly so, throughout the civilised world. As a matter of fact I wrote these words with one of their gold nibs purchased thousands of miles away, and used for many years in the Friendly Islands. It now glides smoothly and silently along, although it is adapted to a different holder and feed arrangement to that for which it was originally intended. The feed arrangement of the "Swan" consists of two parts. The feed bar is of the double type, that is to say, the bar is divided for about one half its entire length into two tongues, between which the gold nib is placed so that there is a tongue on the top of the nib which reaches to within a short distance of its point, and a second tongue lies snugly on the underside of the nib, being about $\frac{1}{8}$th or $\frac{1}{10}$ths of of an inch shorter than the upper one. This feed bar being originally tubular is grooved longitudinally along its inner surface forming ducts whereby the ink is led to the nib. Besides the feed bar proper, there is a twisted silver wire, the polished surface of which repels the ink, and in doing so provides a means of conducting air to the ink chamber, thereby completing the circulation. Without unduly giving prominence to the "Swan" pens, I would say that I have carried one of them for some time, and I have always found it reliable. It is always ready to write as soon as it touches paper, and it has never yet emptied its contents where not required. Mr. Watts, the London manager of this firm, has rendered me much service in connection with my lectures, in showing me many pens now obsolete, whilst on the other hand I have had pleasure in showing to him others, of the existence of which he had not previously known.

In Waterman's "Ideal" Fountain Pen (Fig. 92) the great charm lies in its simplicity. In every fountain pen the feed is the all-important detail that makes or mars its success. The feed of the Ideal is the essence of simplicity. It is strong, and unlikely to get out of order, and it ensures a copious supply of ink at the business end of the nib, without fear of delivering it too quickly. The drawing shows one of these pens in section. It will be noted that the feed bar, B, contains a grooved duct or passage, extending almost to its entire length. This duct is about one-sixteenth of an inch wide, and along the bottom of the duct are parallel saw cuts by which the capillary action is secured. Cross sections of the feed bar were shown earlier. A later improvement has been effected. On either side of the duct, pockets or recesses are formed, which were not shown on the previous drawings. These pockets are designed to collect any surplus ink, and hold it in readiness to meet the requirements of the nib. This form of feed allows practically the whole of the barrel to be at disposal as an ink reservoir, as there are no internal projections. It is stated by the manufacturers that their pens will hold sufficient ink to write from 16,000 to 30,000 words. I have given two of these pens a severe trial, and the only fault I have to find with them is that they will not write without ink. Mr. Symonds, of Messrs. Mordan and Co., as well as Mr. Sloan, of Messrs. Hardmuth and Co., have been good enough to give me many facilities for testing these pens.

FIG. 91.

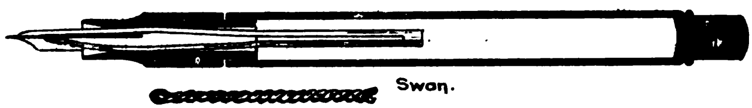
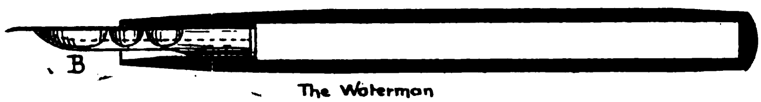
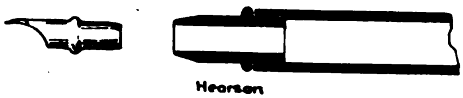


FIG. 92.



In Fig. 93 is a drawing of the "Hearson" pen, consisting of three parts, viz., the reservoir, the point section, and the nib of barrel

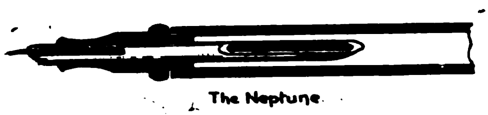
FIG. 93.



type. It will be remembered that this has already been described in detail, as having a steel barrel nib enveloped in an india-rubber casing (see p. 1174).

Fig. 94 shows the feed bar of the "Neptune" Fountain Pen. It will be seen to consist of a tube having a longitudinal slice cut from the rear end, whilst the other or front end is formed into two blades or fingers, one of which lies above the nib, and the other below it, in close contact. Sometimes there is only one finger,

FIG. 94.



or, in other words, a single feed. I need hardly call attention to the fact that there are three different kinds of feed used in fountain pens, viz.:—Single feed, top; single feed, bottom; double feed, top and bottom; one or other of which is adopted.

Fig. 95 is the "Wirt" pen (P. E. Wirt, 1885, 1496). This is a pen of the single feed type. The feed bar, too, is on the top of the nib. The feed bar consists of a single blade of vulcanite, about 2½ inches long, reaching nearly to the point of the nib, and extending backwards into the ink reservoir, the rear part being formed somewhat like a paddle or oar. Air finds its way under the nib, and bubbles upwards through the body of ink, whilst the ink by capillary force is fed along the bar. In general appearance the Wirt pen is very like other fountain pens. I had the good fortune to become possessed of one of these pens, which I used regularly for nine or ten years, and it is still as good as new. The drawing now shown is taken from the pen referred to, and the manufacturers have recently afforded me an opportunity to test a more modern pen, which I find equally efficient.

Moore's "Non-leakable" pen (Fig. 96) is another of those pens designed to prevent leakage when carried in the pocket, and it fully justifies what is thus claimed for it. The pen, or nib, can be drawn within the barrel by means of the slide or thimble, S, attached to the rear end of the elongated feed, F, which passes through the end of the barrel, and is screwed into the plug, P. A stop pin, A, prevents too much movement. The cap is provided with a screw thread, by which it can be securely screwed on the open end of the barrel, thus ensuring a sealed joint. A projecting rod, C, in the cap prevents any injury to the point of the nib when the cap is screwed down, as it abuts against the plug, P, and prevents any movement of the pen. I have given four of these pens a severe trial, and cannot speak too highly of them. They appear to be absolutely non-leakable when closed, no matter in what position they may be carried, and under all conditions they are perfect of their kind.

FIG. 95.

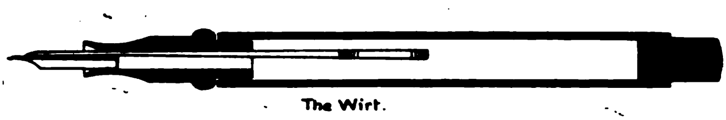


FIG. 96.

The "Horton" pen, shown in section in Fig. 97, is very similar to the following pen. It will be noted, however, that the sleeve nut

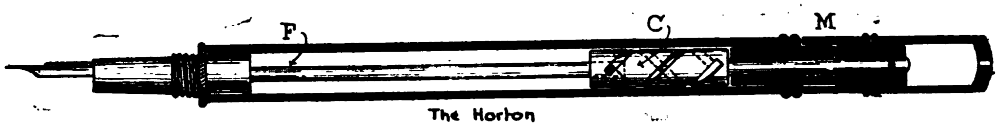
has a double groove or thread, and also that there is a movable point section, but the movements are otherwise identical.

The distinctive feature of "Caw's Safety" Fountain Pen (Fig. 98) is the method whereby the pen-point is made to recede into the ink holder. The illustration shows clearly how this is effected. It will be seen that the feed bar, F, into which is fixed the nib, is elongated, and its rear end enters a cylinder having a spiral groove cut in it. A pin attached to the feed bar passes through the spiral groove, and is free to slide up or down in a straight groove cut in the barrel of the pen. The cylinder, C, is attached to the milled portion, M, of the pen, and on turning M, the cylinder, C, revolves with it, causing the feed bar, F, to travel, and the nib is thus propelled or withdrawn into the reservoir of ink; if the latter is desired, then the cap is screwed on at K, preventing the outflow of ink in whatever position the pen may be carried. It will be evident that when the nib is propelled, the feed bar, enlarged at that point, closes up the restricted aperture of the barrel, so that no ink can escape other than is required to supply the nib. I have tested one of these pens, which Messrs. Eyre and Spottiswoode kindly sent for my inspection a few days ago, and I find that it leaves nothing to be desired.

The "Swift" pen (Fig. 99) belongs to that class which makes special provision against risk of leakage, when out of use or when lying in a horizontal position. This end is accomplished by means of the valve, V, operated from the upper end, E, of the pen, which when screwed down, closes the ink-passage. The feed is of a very simple description, as may be seen. The ink passes along the tapering channel to the under side of the pen, I, air being admitted at the opening, A. The nib being fixed in the slit, N, provided for it. It appears to be identical with W. T. Shaw's patent of 1897, already described and illustrated (see p. 1188).

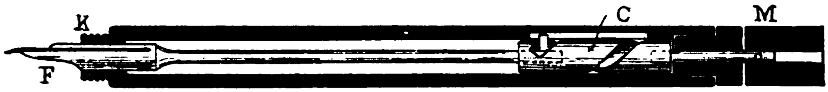
An early form of pen (Fig. 100) of the self-filling type is the "Automatic." The specimen I am about to describe has been in my possesion since about 1878. It is constructed entirely of metal with the exception of the ink container, I, which is a flexible rubber tube closed at one end, and attached to the feed point, F, at the other end. In the casing, B, is an opening, A, placed in such a position that the thumb may

Fig. 97.



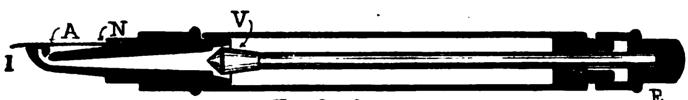
The Horton

Fig. 98.



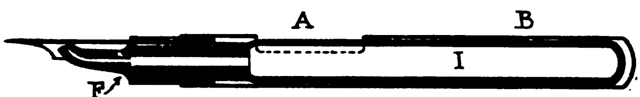
Caw's Safety

Fig. 99.



The Swift

Fig. 100.



The Automatic

readily be placed upon it so as to create a pressure on the ink container, I, and thus force a supply of ink to the nib as required. To fill the pen, the casing, B, is removed, the container is compressed to expel all the air, and placing the point in an ink bottle, the container is allowed to expand when it becomes charged with ink. A cap is provided for the protection of the nib. This pen differs in one respect from that of Michell, in that the ink is delivered underneath the nib, whereas it will be remembered, perhaps, that in Michell's patent, the ink was delivered on the back of the nib (see p. 1177).

The "Conklin" pen, shown in Fig. 101, is an improved form of the "Automatic" just de-

FIG. 101.

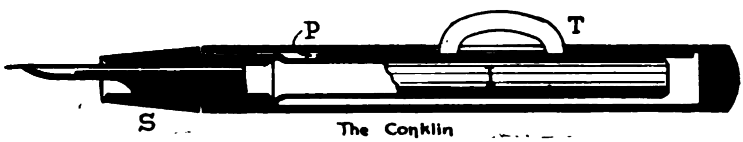


FIG. 102.

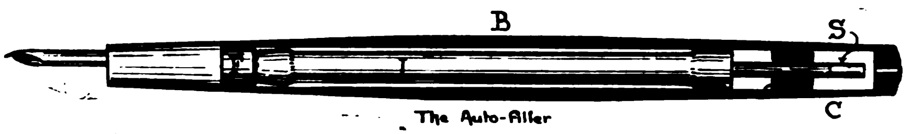


FIG. 103.

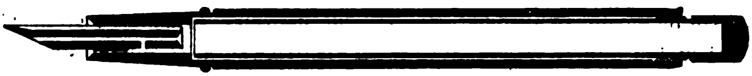
scribed. Its method of refilling is precisely the same, but a pressure bar, P, is provided, which extends practically the entire length of the flexible ink container, I. When the thumb-piece, T, is pressed down the container, I, is flattened, and thus it is emptied of air. The casing of the pen is of vulcanite, and the point section, S, is fitted into it without any screw thread, as an ink tight joint is unnecessary. The ink-container may be readily and cheaply renewed when necessary, and for those who like a self-filling pen this one ought to find favour. The method of filling will be shown presently.

The "Autofiller," shown in Fig. 102, is, as its name implies, a self-filling pen, whose ink container, like that of the "Automatic," consists of a soft rubber tube, I, the rear end of which is closed by a plug, prolonged in spindle form, which spindle, S, projects through the end of the barrel, B, when the small cap, C, is removed. The other end of the container, I, clasps the "feed," F. The spindle, S, may be revolved by the finger and thumb, and the act of doing so causes the rubber container to twist, as the lower end is held fast, thus driving the air out of the container. Placing the point in the ink, and allowing the container to straighten out slowly from its twisted form, the ink quickly rises and fills the container. The disadvantage of these pens lies in the flexible container, which quickly perishes, but a new tube may be had at a very trifling cost, and may be readily substituted for the old one, when the pen will have a new lease of life. The "Autofiller" is very similar to the Conklin pen, the chief difference being the method of manipulating the flexible ink reservoir, by twisting instead of by pressure.

The "Post" pen, illustrated in Fig. 103, and already described, is a pen constructed on the syringe principle. A piston, P, fits the barrel, B, and is operated by the piston rod, R. The idea being to fill the pen by means of the piston arrangement, just as a syringe may be filled. There is nothing special about the feed arrangement, but an ingenious method is adopted of elongating the piston rod. This rod is hollow, and an extension rod, E, is provided, which, when not required for use, slides into the hollow rod, lying snugly out of the way. It may be withdrawn a short distance, and then a couple of turns screws it into the rod, R, thus making it a more convenient length to use. Before replacing the cap which covers

ıe piston rod, when the pen is in use, the rod, , is unscrewed and slid back into R, thus ıaintaining the length of the pen as normal. . small cap is provided to protect the nib 'hen out of use. The "Post" pen is very well

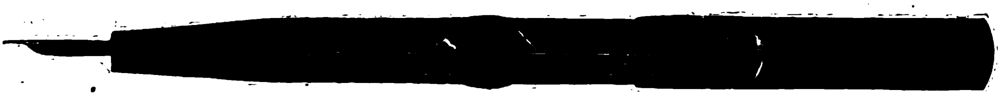
FIG. 104



The Eagle Pencil Co.

FIG. 105.

FIG. 106.



nade, it is an excellent form of self-filling pen, ɔut the ink-holding capacity is small. It may ɔe of interest to state that the Salvation Army s responsible for its introduction into this ɔountry.

Fig. 104 shows a section of the fountain pen of the Eagle Pencil Company, a firm well known for its ingenious automatic pencil holders. It will be seen that the barrel and point section are in one piece, and that a second barrel, screwed into the first at its upper end, reaches downwards to the feed bar. This inner barrel may be entirely removed and filled with ink in the manner generally adopted, and then returned to the position shown in its outer case, thus keeping joints free from ink. The feed bar has a hole drilled right through its centre line from end to end, and a branch leading downwards for the admission of air, whilst ink passes along the groove on its upper side to the underside of the nib, which is not shown in the drawing.

In Figs. 105 and 106 appear two excellent sectional views of the "Conklin" pen. The upper one shows clearly the flexible rubber reservoir fully distended, and ready for use. A metal band passes nearly round the casing and through the opening formed in the thumb-piece of the presser bar. In the position shown in the upper view, the presser bar is inoperative, but when the gap in the metal band is brought into the position shown in the lower view, the reservoir may be compressed for filling.

Fig. 107 (H. Siegert, 1892, 4739) shows a fountain pen in which the penholder, C, is connected by a flexible rubber tube, B, to an ink bottle, E, the tube passing through a cork or stopper fixed in the bottle, and reaching

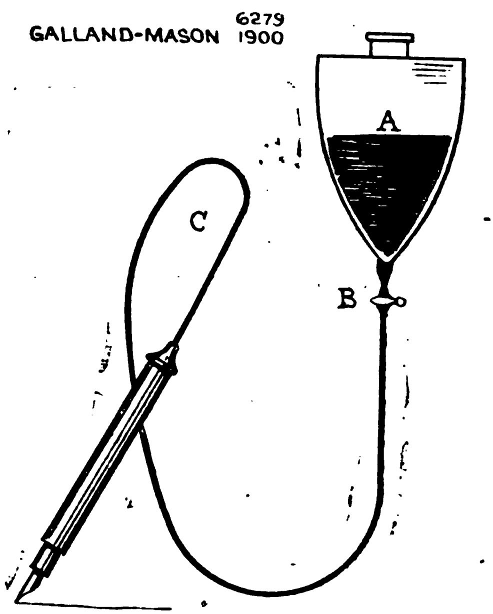
FIG. 107.

down to the bottom. A second tube with a rubber ball, D, also passes through the stopper, but does not reach so far downwards as to

touch the ink. By squeezing the ball, D, the pressure of air is increased and ink is forced into the penholder, C. The inventor suggests that several pens may be connected to the same ink bottle, each having its flexible connection.

In this drawing, Fig. 108 (R. Galland-Mason, 1900, 6279), the ink vessel, A, is connected to a fountain pen by means of a rubber capillary tube, C. The ink flow is regulated by a

FIG. 108.



spring clip, B, which may be placed in any convenient position. The idea is very similar to the previous one, but differs in this respect. In the former case the ink arrives at its destination by a syphonic action, stimulated by the action of the rubber ball, whereas in the latter the ink flows by gravity.

Fig. 109 represents a neat little pen sold by Messrs. Eyre and Spottiswoode at the modest price of threepence. The ink-reservoir is made of brass, as many Birmingham productions are, and it is intended to be used in combination with any ordinary steel nib which may fit. The nib is held in position by the plug of vulcanite shown underneath it, the cut in which gives it a springlike grip. In this respect it is similar to the "Fleet" or "Fenchurch" pen (p. 1198). Ink is fed to the nib by the saw-cut extending along the upper length of the plug, and which, when in position lies immediately under the nib. The stricture shown in the barrel prevents the plug from being thrust too far inwards.

Messrs. Myers and Son have no intention of being outdone in the matter of price, for in Fig. 110 we have a fountain pen retailed at the very moderate price of one penny. He would indeed be a careful man who expected a fountain pen for less. Like the pen just described, the ink reservoir is of brass. The nib, however, is specially made for the pen, and has a grooved air channel extending along from the butt to about half the length of the nib. The nib is held in a metal penholder continued underneath the point of the nib as shown in the drawing, and capable of holding a considerable quantity of ink. A slip of wood is inserted in the rear of the penholder to form an ink feeder.

Messrs. Myers have sent me some of these pens, and I am pleased to find that they are really workable. Truly, no one need be without a fountain pen.

I feel that I have nothing to teach those who have been, and are still, designing fountain pens, but perhaps the general public will allow me to tell them how I keep my fountain pens clean. It is, as I dare say many know to their cost, a great mistake

FIG. 109.

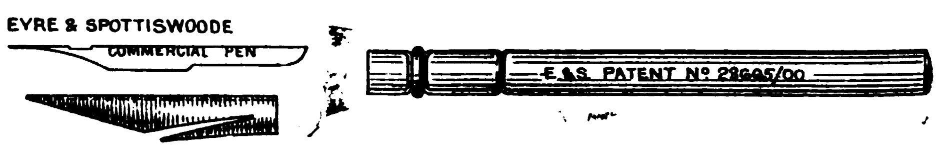
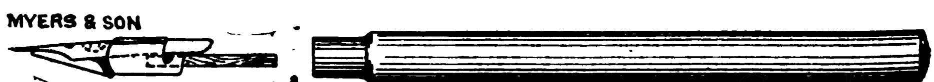


FIG. 110.



for those inexperienced in such matters, to attempt to take all the parts of a fountain pen out of their proper place, owing to the difficulty experienced in putting the various parts back in their correct relative positions. It is also a difficult matter to thoroughly cleanse the minute passages, and free them from foreign matter which will get there, and which becomes hardened and obstructs the flow of ink and air.

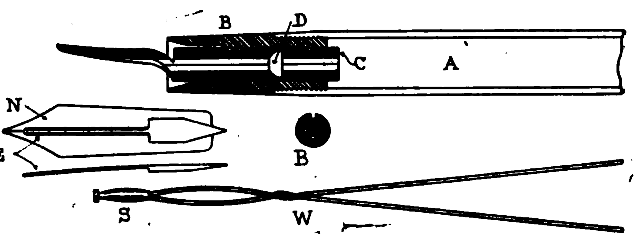
The simple device I have shown in Fig. 111 is most effective in its action. It consists of one of the little pipette tubes supplied with fountain pens, fitted into a cork slightly tapered, as you can see. This I place in the water supply tap, with the result that a fine jet of water is produced, issuing from the point at a considerable pressure, so strong that if the point section of the pen be unscrewed and the jet allowed to play into the passages, all impurities will quickly disappear, and the pen be thoroughly cleansed. This is not patented, but it works just as well as if it were, and I advise fountain pen users to try it.

I now want to show you the internal arrangements of the latest "Swan" pen. Fig. 112 shows the ink reservoir, A, into which is screwed the point section, B. A vulcanite plug, C, fits loosely into the point section, and extends in the form of a tapering finger, underneath the nib, reaching nearly to its point. This plug is pierced along its axis by a rectangular hole, and an enlarged chamber is formed at D. A narrow tongue of metal, E, shaped somewhat like a nib at its rear end, lies along the back of the writing nib, N. The double wire, W, has at one end a tiny tapering plug or stopper, S. When the parts are fitted together, this wire passes through the rectangular hole in the plug, C, and the little stopper, S, occupies a position in the forward end as shown in cross section at B, a round stick in a square hole, thus leaving the four corners open for the admission of air. To fill the reservoir, it is only necessary to slightly withdraw the stopper, S, and the air readily finds its way out, through the square hole referred to, whilst the ink presses inwards.

Mr. Watts kindly sent me two of these pens for experimental purposes, one of these being of ordinary proportions, and the other of noble dimensions. I am much pleased with them, especially the latter, and to give some idea of its capacity for ink as compared with other well-known pens, I have here in Fig. 113 shown it alongside, the "Waterman" pen, a pen of which I cannot speak too highly, whilst below it will be seen the penny pen of Messrs. Myers. Shall I call them "Dignity and Impudence," or "The Sublime and the Ridiculous"?

FIG. 111.

FIG. 112.



One word as to the cap. There appears to be a tendency to provide a cap which perhaps, to many, is clumsy. Its appearance is evident in the drawings of the "Waterman" and the "Swan" pens. To those who want to know why it is being adopted, I would point out that it is designed as a safeguard against any possible leakage at the joint between the ink reservoir and the point section, which it completely covers, and it fulfills its mission admirably. It might, however, in my humble opinion be improved in design.

Finally, I would repeat that it has not been my intention to make invidious distinctions

with regard to any particular make of pen; on the contrary I have endeavoured to describe one and all impartially. Where I have had opportunities of testing any of the pens I have spoken of them as I found them, and when I have had any praise to bestow it has been given because I considered such was due. It must not be understood, however, that many other pens may not have equally good features.

It may possibly have been a shock to some to find that the modern fouutain pen is the outcome of ideas so old, but after all has been said and done, the most ingenious, or the simplest, or the most scientifically designed fountain pen is bound to be a failure unless it be properly made and properly adjusted. Be the invention old, or be it new, it cannot help but fail in its object, if the skilful hand and intelligent mind of the artisan are not brought to bear on its production.

Perhaps a fitting termination to this lecture would be a description of a fountain pen which my friend, Mr. Bennett H. Brough, has brought to light in a volume published in 1723, being an English translation of Monsieur M. Bion's work on Mathematical Instruments, written and published in French some years previously, in which the instrument was called "Plume sans fin," a pen without end. It is, however, in the English translation called a fountain pen. Here is a copy of the drawing (Fig. 114) of the fountain pen which appears in the book, and it will be noticed that the nib employed looks very like a quill. The descriptive matter is very quaint, and I reproduce it here.

Extract from Edmund Stone's translation, 1723, of M. Bion's work on Mathematical Instruments :—

"Of the Fountain Pen.—This instrument is composed of different pieces of brass, silver, &c.; and when the pieces, F, G, H, are put together, they are about five inches long, and its diameter is about three lines. The middle piece, F, carries the pen, which ought to be well slit, and cut, and screwed into the inside of a little pipe, which is soldered to another pipe of the same bigness, as the lid, G; in which lid is soldered a male screw, for screwing on the cover: as likewise for stopping a little hole at the place I, and so hindering the ink from running through it. At the other end of the piece, F, there is a little pipe, on the outside of which the top-cover, H, may be screwed on. In this top-cover there goes a porte-craion, that is to screw into the last-mentioned little pipe, and so stop the end of the pipe at which the ink is poured in, by means of a funnel. When the aforementioned pen is to be used, the cover, G, must be taken off, and the pen a little shaken, in order to make the ink run freely. Note.—If the porte-craion does not stop the mouth of the piece, F, the air, by its pressure, will cause the ink to run out at once. Note, also, that some of these pens have seals soldered at their ends."

FIG. 113.

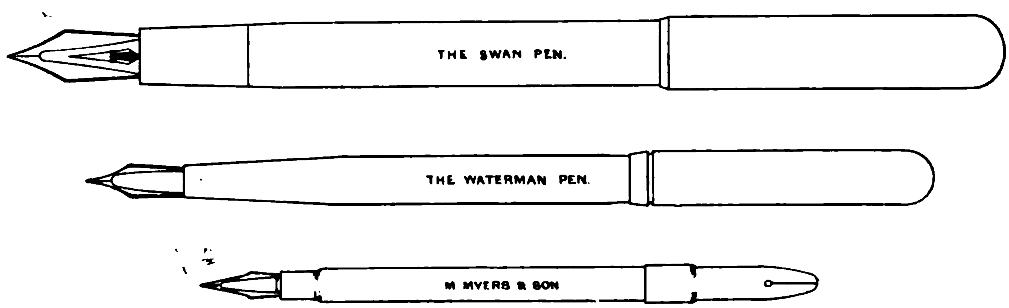


FIG. 114.

HOME INDUSTRIES.

Thames Shipbuilding.—Although the announcement that Messrs. Yarrow and Co. intend to leave the Thames was not unexpected—they have been credited with the intention for the past two years—it is not surprising that it has served to direct attention to the position of industrial London as compared with great provincial centres. Messrs. Yarrow's decision to remove at what must be great inconvenience and cost to themselves is not due to any one cause but rather to many. The popular explanation is the rise in rates, but this is only one, and not the main, consideration that has led to the decision. At 12s. in the £ Poplar is more highly rated than any other district in London, but a saving of £1,000 a year, or something of the kind, would not of itself have induced removal. High rates are only one of the drawbacks with which the shipbuilder has to reckon whose works are on the Thames. The rating of machinery, which is so serious a matter in London, is escaped, or is much lighter, elsewhere; wages are higher in London than in the North, steel plates cost more, coal costs more, material generally costs more on account of the distance which it has to be brought. In leaving London Messrs. Yarrow do not make a new departure. They follow where others have led. Allen's have gone to Bedford; Willans and Robinson to Rugby; Simpson to Newark; Siemens are doing much of their work at Stafford, and Thornycrofts at Southampton. Messrs. Yarrow have held on longer than most, but they too have to bow to the economic causes that have prevailed with other firms.

The Foreign Transhipment Trade.—It is with shipbuilding on the Thames as with its foreign transport trade, consisting in the import of goods destined for immediate or eventual transport to the Continent of Europe, or to other parts of the world. Both the inland and the export trade of London have lost ground relatively to other ports, and to a large extent this has been unavoidable. Formerly, as Mr. D. Owen, a high authority on the subject, pointed out in his evidence before the Commission on the Administration of the Port of London, London was a distributing and collecting port, as being the world's trade focus, the world's market. The cargoes came to the biggest market. The Low Countries and the Continent bought in London, and sent goods to London for shipment. London was the "goods exchange" for Europe to a large extent. But the position is greatly changed. The abolition of the Scheldt dues threw open Antwerp, which at once began to compete with London. The opening of the Suez Canal was soon followed by ships being ordered with full cargoes to Antwerp, Hamburg, Rotterdam, Havre, and other places. This competition, powerful as it is, is still only in its infancy. Continental ports are spending lavishly on improvements, and it seems inevitable that the business of London as a port of distribution will decline. And so with shipbuilding. Time was when the shipyards in the Isle of Dogs alone employed from ten to twelve thousand men, but the industry began to move away when rates were only half their present figure. The shipyards are gone, but notwithstanding the rates other industries have taken their place. There is a big jam factory on the site of the yard which built the Great Eastern, and other yards are now occupied by chemical works, an American oil company, and provision works.

Provincial Shipbuilding.—The principal centres of shipbuilding in England have been the Thames, the Tees, the Tyne, and Sunderland on the east coast, and Liverpool, Barrow, and Whitehaven on the west. How seriously London has suffered as compared with other ports will be seen from the following figures which give the number and net tonnage of sailing and other ships built for home requirements in London and elsewhere in recent years:—

	1900.		1904.	
	No.	Net tonnage.	No.	Net tonnage.
London	222	15,424	59	4,040
Newcastle	42	85,128	62	108,047
West Hartlepool ..	22	48,858	19	37,019
Sunderland	54	122,580	63	133,267

These figures show that whilst even in 1900 London had ceased to be a leading shipbuilding centre for home demands, four years later her position was much worse. It is the same if the figures are taken of iron, steel, and wooden sailing and steam vessels built during the year 1904 at ports in the United Kingdom for foreigners:—

	Sailing.		Steam.		Total.	
	No.	Tons net.	No.	Tons net.	No.	Tons net.
London ..	7	347	22	1,153	29	1,500
Newcastle .	—	—	20	32,721	20	32,721
Sunderland	—	—	18	29,042	18	29,042
West Hartlepool ..	—	—	6	12,661	6	12,661
Glasgow ..	28	3,914	31	4,155	59	7,610
Belfast....	—	—	1	669	1	669

Of war vessels Sunderland, West Hartlepool, Glasgow, and Belfast built more, but London built seven small boats of a tonnage of 451 tons, and Newcastle a single vessel of 1,596 tons net. It looks as if before many years have passed London will have ceased to build ships for the foreign as well as the home market.

The Match Trade.—Another company employing a large number of hands in the East End is that of Bryant and May, Limited, the well-known match manufacturers. Located in the district ever since the early days of the match industry, the now well known

"safety matches," invented by Lundström of Sweden in 1855, were first manufactured in the United Kingdom by Bryant and May, who can point to a very prosperous past, but like Messrs. Yarrow they have been considering the advisability of moving their works. "We are," said the managing director last week, "owing to the higher rates, seriously considering the question of moving." The competition in the match trade is very keen, Sweden being the most formidable rival of the English manufacturers, but other countries send us very large supplies as will be seen from the following figures:—

	Gross of Boxes.		Value, 1904.
	1900.	1904.	
			£
Sweden ..	5,293,792	5,620,546	306,365
Belgium ..	1,742,238	2,132,344	97,199
Holland ..	342,475	433,304	18,557
Norway ..	332,210	712,384	35,231

It will be noted that although the imports from abroad are enormous, amounting in 1904 from the four countries named to no less than 8,898,578 gross of boxes, with the exception of Norway, which has more than doubled its export, they do not show any very rapid increase in the four years although in each case there is increase. There can be no doubt that, more especially in Norway and Sweden, the conditions of manufacture are very favourable as compared with England. For example, the wages of the unskilled workman in Sweden average 8s. 2d. per week. It is not surprising that with the foreign article admitted free, and prices here making it possible to buy matches that are not the cheapest for 2½d. the dozen boxes—they can be got for 1½d.—abnormally heavy rates are a serious factor with match manufacturers located in London.

London and Provincial Wages.— Upon the question of wages in London shipbuilding yards, it may be interesting to compare them with the rates ruling elsewhere. The figures below are taken from the Tenth Abstract of Labour Statistics of the United Kingdom, 1902-1904 (Cd. 2491):—

Boiler Maker's and Iron Shipbuilders' Weekly Rate of Wages (new work).

	Platers' (heavy).		Platers' (light).		Rivetters.		Weekly Hours of Labour.
	Boiler Shops.	Ship-yards.	Boiler Shops.	Ship-yards.	Boiler Shops.	Ship-yards.	
London	45/-	45/-	42/-	45/-	38/-	38/-	54
	48 ‡	48/-	45/-	48/-	42/-	42/-	45½
Newcastle	40/6	35/-	38/6	35/-	37/6	33/-	53, 54, 48½†
Sunderland	41/-	35/-	39/-	35/-	37/6	33/-	53, 47†
Glasgow ..	41/9	36/-	38/4½	36/-	36/1½	33/9	54
Belfast ...	42/6	38/6	42/6	...	37/-	35/6	54

† In shipyards in winter. ‡ Repair work.

It will be seen that the London wages are considerably higher all round, and the figures given above do not disclose the whole difference. For night work, London men want to be paid at the rate of time and a-half. In the North, the men get time and a quarter, or time and one-eighth. Again, the rating of machinery in London is a serious matter. In some of the poor and industrial boroughs it is rated as high as 10 per cent. of its capital value, which means, with rates, as in Poplar, at 12s. in the £, that for every £1,000 worth of machinery there is an addition of £60 to the rate-toll. If this burden was uniform all over the country, it would be borne with less complaint. But it is not so. As was recently explained in the *Journal*, the general uncertainty as to what may, or may not, be done in this direction has tempted many local authorities to make assessments, whilst others make none. Thus, in Westminster, machinery is not rated, in the City of London it is partially rated; in Poplar it is heavily rated, in Manchester it is not rated at all. This lack of uniformity causes confusion and ill-feeling, and presents itself as an unfair burdening of manufacturers resident in certain localities. It is to be hoped that the Bill which has been before Parliament many years, and is intended to secure uniformity of rating in accordance with the recommendation of two Royal Commissions, will soon become law, and so put an end to an irritating anomaly.

GENERAL NOTES.

PROPOSED COMMERCIAL AGENTS FOR THE COLONIES.—Mr. C. F. Just in the paper he contributed to the Colonial Section last session on the manufactures of Canada, advocated the creation of a service of commercial agents to reside in British possessions for the purpose of reporting to the Commercial Intelligence Branch of the Board of Trade in London, "on all matters concerning the resources, growth, local enterprises, public contracts, openings for trade, and the investments for capital," as is done by His Majesty's consular officers and commercial *attachés* in regard to foreign countries. The superintendent of Commercial Agencies in Canada has expressed his firm conviction that the establishment of such a service would be of immense benefit to the Empire at large. He adds that there is not in the whole of Canada a British official who can answer questions of the British exporter concerning Canada, while the Americans "have in the neighbourhood 190 officials."

BRITISH SOLOMON ISLANDS.—At present the trade of the Protectorate is done exclusively with Sydney, and this is due to the fact that there is no steam communication with any other place. But it cannot be said that Sydney does much to help the Protectorate. Of its exports, copra

at present enters Australia free of duty, some being manufactured into oil and oil cake in Sydney, but most of it is re-exported to Europe. Under the operation of the New South Wales Harbour Rates Act copra manufactured into oil and oil cake in Sydney is subject to a wharfage charge of 10d. per ton, while copra entering Sydney for re exportation pays a wharfage charge of only 5d. per ton. The other articles of export from the Protectorate are all re-exported from Sydney to Europe with the exception of *bêche de-mer*, which goes to China. In his report on the islands just published, the Commissioner, Mr. C. M. Woodford (Cd. 2684) anticipates that Sydney will before long lose this trade. The output of copra will have so much increased that either a mill for crushing will be erected in the Protectorate, or the copra will be freighted direct to Europe in sailing vessels. And if, as is likely, the Nord Deutsche Lloyd Company, having practically closed the German New Guinea Colony and the Bismarck Archipelago to Australian steamers, extend their voyages to the British Solomon Islands Protectorate, and offer better terms of freight than those now prevailing, as they would be able to do in consequence of the heavy subsidies and concessions received from the German Government, a large proportion, at least, both of the export and import trade of the islands will be diverted from Sydney to Singapore.

CAPE TOWN PHOTOGRAPHIC SOCIETY. — A photographic exhibition will be held at the City Hall, Cape Town, from Saturday, February 3rd, to Saturday, Febuary 10th (inclusive), under the patronage of the Governor. Entries close January 13th, 1906. Section A is open to members of any photographic society in South Africa. Section B is international and open. Section C is international and open, and includes scientific and technical photography, and its application to processes of reproduction.

BRITISH SCIENCE GUILD.—The Inaugural Meeting of the British Science Guild, held at the Mansion House, has had the effect of largely increasing the list of applications for membership. Sir Norman Lockyer desires it to be known that would-be members should apply for particulars to the Honorary Secretary, 16, Pen-y-Wern-road, S.W.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 13...Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. (Graduates Section.) Mr. Edward Barrs, "Boiler House Practice and Design."

Surveyors, 12, Great George-street, S.W., 8 p m. The First Ordinary General Meeting of the Session 1905-1906. Opening Address by the President, Mr. Charles Bidwell.

London Institution, Finsbury-circus, E.C., 5 p m. Prof. E. Ray Lankester, "The Origin of the Elephant."

TUESDAY, Nov. 14....Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. John Arthur Saner, "Waterways in Great Britain."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. Walter Kidd, "The Papillary Ridges in Mammals, chiefly Primates." 2. Mr. J. Lewis Bonhote, "A collection of Mammals brought home by the Tibet Frontier Commission." 3. Dr. Einar Lönnberg, "Notes on the Geographical Distribution of the Okapi." 4. Major George H. Evans, "Notes on Goral found in Burma." 5. Miss Dorothea M. A. Bate, "The Mammals of Crete."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Sir J. Athelstane Baines, "Statistical Skimmings from the International Congress."

Colonial Inst., Whitehall Rooms, Whitehall-place, S.W., 8 p m. Mr. W. J. Sowden, "The Anglo-Australian position from an Australian point of view."

WEDNESDAY, Nov. 15...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Sir Owen Roberts, Chairman of the Council, "Inaugural Address of the 152nd Session."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Sir John W. Moore, "The Rainstorm of August 24th-26, 1905, in Co. Dublin and Co. Wicklow." 2. Dr. William B. Newton, "The Aquameter."

Microscopical, 20, Hanover-square, W., 8 p.m. Exhibition of Microscope Slides of Tsetse-Fly Dissections, Trypanosomes, &c.

THURSDAY, Nov. 16 ..Linnean, Burlington-house, W., 8 p.m. 1. Miss Margaret Benson, Miss Elizabeth Sanday, and Miss Emily Berridge, "Contributions to the Embryology of the Amentiferae," Part II. 2. Prof. Chas Stewart, "The Ears of Certain Sharks."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. J. E. Reynolds, "Silicon Researches (Part IX.) Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (Si N)." 2. Messrs. J. E. Marsh and R. de J. F. Struthers, "Condensation of Ketones with Mercury Cyanide." 3. Messrs. G. Barger and A. J. Ewings, "Application of the Microscopic Method of Molecular Weight Determination to high Boiling Solvents." 4. Mr. R. G. Durrant, "Green Compounds of Cobalt produced by Oxidising Agents." 5. Mr. W. H. Perkin, Jun., "Synthesis of Tertiary Menthol and of Inactive Menthene." 6. Messrs. R. H. Pickard and A. Neville, "Optically Active Reduced Naphthoic Acids, Part I. Dextro-dihydro-1-naphthoic Acid."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Hilaire Belloc, "The Oldest Road in India."

National Indian Association, in the Jehangir Hall, Imperial Institute-road, S.W., 4½ p.m. Mr. Theodore Morrison, M.A., "Indian Muhammadans and European Culture."

FRIDAY, Nov. 17...Art Workers' Guild, Clifford's-inn Hall, Fleet-street, E.C., 8 p.m.

Architectural Association, 18, Tufton-street Westminster, S.W., 7½ p m. Mr. J. A. Gotch, "Old Manor Houses."

Mechanical Engineers, Storey's Gate, Westminster, S.W., 8 p.m. Dr. H. C. H. Carpenter, Mr. R. A. Hadfield and Mr. Percy Longmuir. The Seventh Report to the Alloys Research Committee: "On the Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys."

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of Transactions of Societies and other Periodicals.

TRANSACTIONS, &c.

Aeronautical Society, Journal.
African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Chemical Society, Journal.
American Institute of Architects, Bulletin.
American Institute of Electrical Engineers, Proceedings.
American Institute of Mining Engineers, Transactions.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Proceedings.
American Society of Mechanical Engineers, Transactions.
Architectural Association, Notes.
Association of Engineering Societies (American), Journal.
Australasian Association for the Advancement of Science, Report.
Bath and West of England Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Fire Prevention Committee, Publications.
British Horological Institute, Horological Journal.
Brussels, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Patent Office, Record.
Canadian Society of Civil Engineers, Transactions.
Central Chamber of Agriculture, Proceedings.
Ceylon, Planters' Association, Year Book.
Chartered Institute of Patent Agents, Transactions.
Chartered Institute of Secretaries, "The Secretary."
Chemical Society, Journal.
Chicago, Western Society of Engineers, Journal.
———, Field Columbian Museum, Publications.
Civil and Mechanical Engineers' Society, Transactions.
Cleveland Institution of Engineers, Proceedings.
Cold Storage and Ice Association, Proceedings.
Cornell University, Physical Review.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institute, Journal.
Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Haarlem, Koloniaal Museum, Bulletin.
Imperial Department of Agriculture for the West Indies, Publications.
Imperial Institute, Bulletin.
India, Geological Survey, Memoirs and Palæontologia Indica.
India, Government of, Agricultural Ledger.
Indian Meteorological Department, Memoirs.
Institute of Bankers, Journal.
Institute of Chemistry, Proceedings.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
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Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Gas Engineers, Transactions.
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Iron and Steel Institute, Journal.
Japan, College of Science, Imperial University, Journal.
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Junior Institution of Engineers, Record of Transactions.
Kew Gardens Bulletin.
Linnæan Society, Journal.
Liverpool Engineering Society, Transactions.
Liverpool Literary and Philosophical Society, Proceedings.
London Chamber of Commerce, Journal.
Manchester Literary and Philosophical Society, Memoirs and Proceedings.
Manchester Steam Users' Association, Reports.
Munich, Polytechnische - Verein, Bayerisches Industrie-und-Gewerbeblatt.
National Association for the Promotion of Technical and Secondary Education, "Record."
National Indian Association, "The Indian Magazine and Review."
National Service League, Journal.
New South Wales, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Memoirs.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions.
Odontological Society, Transactions.
Paris, Comité International des Poids et Mesures, Procès Verbaux.
——, Conservatoire National des Arts et Métiers, Annales.

Paris, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.
——, Société Internationale des Electriciens, Bulletin.
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Royal Horticultural Society, Journal.
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal and Record.
Royal National Life Boat Institution, "The Life Boat" and Annual Report.
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
Royal Statistical Society, Journal.
Royal United Service Institution, Journal.
Sanitary Institute, Journal.
Smithsonian Institution, Report and Publications.
Society of Antiquaries, Archæologia and Proceedings.
Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Dyers and Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South Wales Institute of Engineers, Proceedings.
Victoria Institute, Journal of the Transactions.
Wisconsin Academy of Sciences, Transactions.

JOURNALS.

Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Athenæum.
Automobile Club Journal.
Automotor.
Board of Trade Journal.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
Building News.
Cabinet Maker and Art Furnisher.
Chemical News.
Chemist and Druggist.
Colliery Guardian.
Cosmos: Revue des Sciences.
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Moniteur Industriel.
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Page's Weekly.
Photographic News.
Photography.
Practical Engineer.
Produce Markets' Review
Public Health Engineer
Publishers' Circular.
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Shipping World
Spectator.
Surveyor.
Textile Mercury

Fortnightly.

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Finance Chronicle.
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Madrid Cientifico.
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Quinzaine Coloniale.
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Building Societies' Gazette.
Caterer and Refreshment Contractors' Gazette.
Coach Builders' and Wheelwrights' Art Journal.
Cold Storage and Ice Trades Review.
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Engineering Magazine.
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Foundry Trade Journal.
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Indian and Eastern Engineer.
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Oils, Colours, and Drysalteries.
Paper Makers' Monthly Journal.
Philosophical Magazine.
Photographic Times (New York).
Piano Journal.
Plumber and Decorator.
Pottery Gazette.
Process Photogram.
Propriété Industrielle (Berne).
Railway Engineer.
Revue de l'Ingénieur.
Revue du Travail (Brussels).
Revue Mineralurgique.
Science Abstracts.
Symons's Meteorological Magazine.
Textile Manufacturer.
Textile Recorder.
Textile World Record (Boston).
Watchmaker, Jeweller, and Silversmith.
Water.
Woodworker.

Quarterly.

Art Workers' Quarterly.
Climate.
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Quarterly Review.
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West Indian Bulletin.

NEWSPAPERS.

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Cape Times (Weekly Edition).
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Englishman (Calcutta).
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Times of India (Overland Weekly Edition).
West African Mail.

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